Senegal, Benin, Ghana, Tanzania, Mozambique, Nigeria, Kenya, Uganda, Rwanda, Zambia

Survey and Research to Promote the Utilization of Science, Technology and Innovation for Solving Social Development Issues in the Africa and Sub-Saharan Africa Regions

Final Report

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Japan International Cooperation Agency

Deloitte Touche Tohmatsu LLC

Deloitte Tohmatsu Venture Support Co., Ltd.

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Survey Target Countries

List of Abbreviations

AFD	Agence Française de Développement
AI	Artificial Intelligence
B to B	Business to Business
CAADP	Comprehensive Africa Agricultural Development Program
CARD	Coalition for African Rice Development
CDB	China Development Bank
CeCPA	Centre Communal de Promotion Agricole
CeRPA	Centre Régional de Promotion Agricole
CHPS	Community Based Health Planning and Services
DADP	District Agricultural Development Plan
DHIMS	District Health Information Management System
DPH	Direction de la Production Halieutique
EC	Electronic Commerce
EMBRACE	Ensure Mothers and Babies Regular Access to Care
FAO	Food and Agriculture Organization of the United Nations
GAFSP	Global Agriculture and Food Security Programme
GDP	Gross Domestic Product
GHA	Ghana Highway Authority
GHS	Ghana Health Service
GPS	Global Positioning System
GRPTU	Ghana Private Road Transport Union
ICT	Information Communication Technology
IFC	International Finance Corporation
IFP	Instituto de Formação de Professores
IMF	International Monetary Fund
IoT	Internet of Things
IPRC	Integrated Polytechnc Regional College
IT	Information Technology
ITU	International Telecommunication Union
JETRO	Japan External Trade Organization
LGA	Local Government Authorities
MAEP	Ministère de l'Agriculture, de l'Élevage et de la Pêche
MDGs	Millennium Development Goals
MRH	Ministry of Roads and Highways
NGO	Non Governmental Organization
NIMP	The National Irrigation Master Plan
NIRC	National Irrigation Commission
O&M	Operation and Maintenance
ODA	Official Development Assistance
OI	Open Innovation
PAG	Programme d'Action Gouvernement
PoC	Proof of Concept
SDGs	Sustainable Development Goals
SIGICMU	Le Système d'Information de Gestion Intégré de la Couverture Maladie Universelle
SMS	Short Message Service
STI	Science, Technology and Innovation
TICAD	Tokyo International Conference on African Development
TLO	
UHC	Universal Health Coverage

USAID	United States Agency for International Development
VAT	Value-added tax
VC	Venture Capital
WFP	World Food Programme
WHO	World Health Organization

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Summary

In order to achieve the ambitious and wide-ranging goals of the Sustainable Development Goals (SDGs) in Africa, new methods are required to solve problems that cannot be solved by conventional approaches. There are high expectations for the use of Science, Technology, and Innovation (STI) and the formation of projects through collaboration and co-creation (open innovation) involving private companies, academic research institutions, and investors with superior digital technologies. In this background, JICA conducted the "Open Innovation Information Collection and Confirmation Survey on Disruptive Digital Technologies in Africa" from February 2019, in which JICA implemented a trail of the Africa Open Innovation Challenge, an open innovation program to generate ideas for solving development issues in specific fields (e.g., agriculture) using STI in Kenya, Rwanda, Uganda, and Nigeria (for both private companies and Japanese KOSEN).

Following the abovementiond survey, this survey aims to continue, as the Africa Open Innovation Challenge, inviting ideas for solving problems through open innovation, and attempting to test and introduce specific solutions. The main purpose of this survey is to prepare and study the implementation system within and outside of JICA as well as the target countries in order to promote the program for STI utilization in Sub-Saharan Africa through the trial operation of the open innovation platform to connect companies with solutions to local development issues and the Proof of Concept (PoC) of the actual application of the solutions.

The Chapter 1 explains the background, objectives, and implementation policy of this research. The Chapter 2 describes the results of information collection survey on the target sectors in each country, including basic information, the current status of the use of various digital technologies that contribute to solving problems, and international trends in STI ultilization initiatives in the target sectors. In the Chapter 3, it is explained how to narrow down the themes suitable for the Africa Open Innovation Challenge based on the collected information. Initially, there were several candidates for the target sectors in each country, but the following sectors and themes were finally selected. Then, the Chapter 3 describes the process of the call for solutions and selection by the Africa Open Innovation Challenge for private sector, as well as the PoC implementation and results.

Table: Overview of the Africa Open Innovation Challenge for Private Sector

	Country	Corporate	Products & services	Exit Strategy	Good Factors/Background
Private Sector	Ghana and Zambia	Augumenta	Smart glasses	Utilization in JICA projects	PoC implementation in collaboration with TCP, which has a need for remote training in COVID-19 situation.
	Senegal	Maad	Tablet application	Utilization in JICA Technical Cooperation Project	Active involvement of C/P (SAED) and JICA experts to improve operational efficiency by using digital technology
	Senegal	JIRAS	Weather forecast	IDs provision for demo version to C/P, JICA Technical Cooperation Project, JIRCAS' own budget to continue	Active involvement of C/P (SAED) and JICA experts to improve operational efficiency by using digital technology
	Benin	DIVE INTO CODE	Learning programming	Private sector's own business	The company has strong intention to continue and well-connected local partner in addition to the active involvement of ADN
	Tanzania	Syno Japan	Agricultural marketing	Utilization in JICA Technical Cooperation Project	Active involvement of JICA experts to improve development impact by using digital technology and the possibility of more deployment
	Tanzania	Hakki	Credit scoring	Private sector's own business	The microfinance market in Kenya and Tanzania is active and technical availability has been confirmed
	Mozambique	Hylable	Visualizing dialogue in education fields	Private sector's own business	Cooperation with local stakeholders (IFP, MINEDH, etc.)

Source: JICA Survey Team

In addition to the open innovation for the private sector, the Africa Open Innovation Challenge for Japanese KOSEN was also implemented, and the results are summarized in the Chapter 4.

Table: Overview of the Africa Open Innovation Challenge for KOSEN

	Country	Local Partner	Themes (Challenges)
KOSEN	Rwanda	Integrated Polytechnic Regional College Thumba	Call for ideas to prevent the spread of COVID-19 infection through the power of digital fabrication!
	Mozambique	Nippon Biodiesel Fuel Co., Ltd.	Promoting the digitization of rural areas! Call for ideas of radio wave map made and shared by everyone!
	Tanzania	WASSHA Inc.	Improving rice trade prices! Call for ideas for a stone removing machine with a simple mechanism!
	Ghana	Nelplast Ghana Ltd	Call for Ideas for improving the productivity and quality of paving blocks using waste plastic!

Source: JICA Survey Team

The Chapter 5 summarizes the results of the trial operation of the open innovation platform and the lessons learned from the results of the PoC in each country. As for the operation of the open innovation platform, there could be a way to use similar services from outside, but JICA itself already has both information on local development issues and information on companies with potential solutions to such issues.Therefore, it is suggested that JICA could become a driver of open innovation in the field of international development more than ever before if JICA appropriately makes the most use of this information as a database. Moreover, most of the coporates that implemented each PoC were able to seize the opportunity to promote their own business or to collaborate with JICA projects.

Then, by comparing the Africa Open Innovation Challenge with JICA's existing schemes, multiple lessons learned were drawn, such as a needs-driven approach rather than a supply-driven approach, matching based on an understanding of both the issues and the solutions, involvement of relevant stakeholders in PoC implementation, flexible procurement mechanism, localizing the solution to meet local needs, and rapid PoC implementation (quick process in terms of administrative procedures).

Finally, the Chapter 6 summarizes the recommendations for the continued operation of the Africa Open Innovation Challenge from the perspectives of operational policies, management methods, and management structure. The value of the Africa Open Innovation Challenge is to provide an opportunity for the private sector to try out their solutions to problems that are difficult to solve through conventional projects. In terms of practical operations, it is important to have a mechanism to continuously absorb high-quality challgenges (adequate issues to be tackled by digital solution) from the field and to set up an exit strategy in advance. For this purpose, it is necessary to assign a person in charge of open innovation and to train personnel who have knowledge of both issues and solutions and can realize proper matching. Forthermore, the activity of the PoC by JICA and the private companies can be continued and its impact can be expanded through collaboration with various actors such as partner governments, other donors, private companies, and investors. It is essential to actively promote the establishment of relationships (network building) that will lead to the spread and expansion of the impact of the open innovation.

Chapter 1 Overview of Survey

1.1 Background and Objectives of the Survey

1.1.1 Background

In order to achieve the ambitious and wide-ranging goals of the Sustainable Development Goals (SDGs) in Africa, the use of science, technology and innovation (STI) is expected to achieve more comprehensive and sustainable development, although it is important to use problem-solving methods that cannot be solved by conventional efforts. In preparation for the Seventh African Conference on Development (TICAD7) held under these circumstances, the STI Task Force was launched within your organization in 2018, and the theme of TICAD7 will be People, Technology and Innovation, and the promotion of STI is required as a follow-up.

STI enables "leapfrog" type solutions that leapfrog from "Business As Usual", as well as scaling up and spreading out of good practices that are highly inclusive initiatives to "leave no one behind". In order for African countries to engage in STI-enhanced development, it is essential to strengthen their capacity in areas such as human resource development and to improve their existing systems, including infrastructure. The goal is to match science and technology with the social issues and needs of Africans, while utilizing the knowledge of your organization's past cooperation.

Based on this background, the "Open Innovation Information Collection and Confirmation Survey on Disruptive Digital Technologies in Africa" (hereinafter referred to as the 1st Survey) was conducted in Kenya, Rwanda, Uganda, and Nigeria (hereinafter referred to as the target countries of the 1st Survey), and discussions were held with various actors in each country, including Japanese companies, foreign companies, investors, and public institutions. In each of these countries, we are trying to formulate projects (open innovation) through collaboration and co-creation with various actors, including Japanese companies, foreign companies, investors, and public institutions through discussions, brainstorming, and workshops, and are conducting Proof of Concept (PoC) experiments to realize the ideas generated.

The 1st Survey focused on stakeholder community building, which is the foundation of open innovation, with the main objectives of improving awareness of development issues and opportunities, stakeholder involvement, and idea generation. It means that the efforts toward practical commercialization were limited. Therefore, as the next step, this survey was planned to examine the projects formulation leading to practical business and/or further ODA projects.

Based on the results of the 1st Survey and the discussions at TICAD7, JICA have been planing to establish the "STI for TICAD Open Innovation Platform". The platform will serve as an intermediary (catalyst) to connect the social issues (needs) faced by developing countries with the knowledge, experience, and technology (seeds) possessed by Japanese stakeholders in order to promote the creation of more solutions to development issues using STI.

In this study, based on the results of the 1st Survey, we planned to conduct a trial of the platform and collaborate with other stakeholders in Japan and overseas, as well as financial institutions including venture capitalists, to promote the establishment of a collaborative system for connecting Japan and overseas. In addition, we planne to promote the functioning of the platform to connect Japan and overseas by collaborating with the platform.
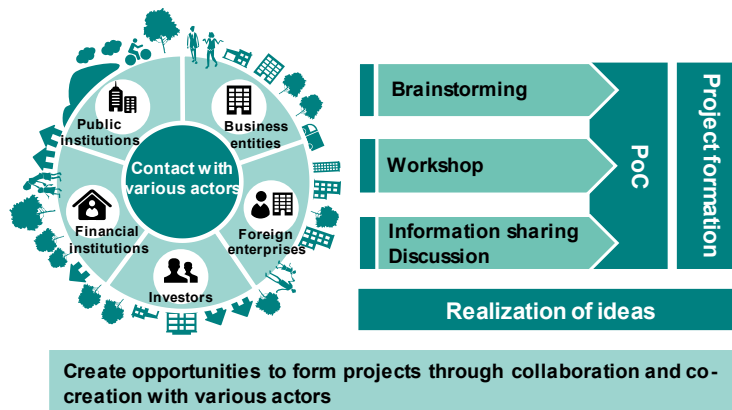
Figure 1-1　Example of creating good practices through innovation

Source: JICA Survey Team

In addition, based on the results of the 1st Survey, it is planned to try to solve specific development issues in cooperation with technical cooperation projects and technical experts related to this research that your organization is implementing in Africa, while actively adopting the open innovation method. In addition, we planned to mainly focus on Western and Southern African countries that were not covered in the first round of the survey, and we planed to study the solution of the issues, including peripheral issues, while adopting the open innovation method, mainly with a view to solving the issues of the technical cooperation projects.

1.1.2　Objectives

Based on the results of the 1st Survey, the purpose of this study is to prepare for and examine the implementation and management of STI promotion programs in Sub-Saharan Africa, including the establishment of implementation systems within and outside the target countries and your organization. In addition, this survey aims to compile recommendations based on the knowledge accumulated through the operation of the platform. In addition to investigating the applicability of STI in Senegal, Benin, Ghana, Tanzania, Mozambique, and Zambia (hereinafter referred to as the "new target countries"), which were added as the new target countries in this study, we also plan to investigate the possibility of incorporating technologies and ideas from private companies, governments, various organizations, and academic institutions through open innovation. The purpose of this project is to investigate the possibility of applying STI in Tanzania, Mozambique, and Zambia (hereinafter referred to as "new target countries"), as well as to examine ways to solve development issues in Africa by incorporating technologies and ideas from the private sector, government, various organizations, and academic institutions through open innovation.

1.2　Project implementation policy

1.2.1　Workflow

This survey was conducted according to the workflow shown in the figure below. It was originally scheduled to be completed by the end of March 2021, but was extended for about a year due to the impact of COVID-19.

example :　■ field work　□ work in Japan

items / period	2020	2021	2022
	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec	Jan Feb Mar

【The 1st work in Japan】 (the end of Jan, 2020 to the end of Feb, 2020)

#	Item	Timing
①	Preliminary survey on new target countries	work in Japan: Feb 2020
②	Planning of the KOSEN Innovation Challenge	work in Japan: Feb 2020
③	Support for selection of PoC entities	work in Japan: Feb 2020
④	Design for platform	work in Japan: Feb 2020
⑤	Preparation of inception report	work in Japan: Feb 2020

【The 1st field work】 (the end of Feb, 2020 to the mid of Mar, 2020)

#	Item	Timing
①	Evaluation of STI applicability in new target countries	field work: Mar 2020
②	Preparation for the KOSEN Open Innovation Challenge	field work: Mar 2020
③	Preparation of PoC for the phase 1 countries	field work: Mar 2020
④	Confirmation of data to be input to the platform	field work: Mar 2020

【The 2nd work in Japan】 (the end of Mar, 2020 to the end of Jan, 2021)

#	Item	Timing
①	Examination of Open Innovation Theme	work in Japan: Apr–Jul 2020
②	Examination of collaboration between JICA and Japanese stakeholders and implementation of open innovation	work in Japan: Apr–Jul 2020
③	Review of results of open innovation	work in Japan: Aug–Sep 2020
④	Support for PoC implementation	work in Japan: Oct 2020–Jan 2021
⑤	Gathering information for building the platform	work in Japan: Apr–Oct 2020
⑥	Preparation of field survey plan	work in Japan: Dec 2020

【The 2nd field work】 (the begging of Mar, 2021 to the end of May, 2021)

#	Item	Timing
①	Conducting field surveys: new target countries	field work: Mar–May 2021
②	Support for PoC implementation: brush up business models, conduct demonstrations	field work: Mar–May 2021
③	Review of ideas from open innovation and business models, and demonstration of prototypes	field work: Mar–May 2021
④	Consideration of ways to realize promising ideas	field work: Mar–May 2021

【The 3rd work in Japan】 (the beginning of Feb, 2021 to the mid of Mar, 2021)

#	Item	Timing
①	Compilation of field survey results	work in Japan: Feb–Mar 2021
②	Support for PoC implementation	work in Japan: Feb–Mar 2021
③	Gathering information to be posted on the platform	work in Japan: Feb–Mar 2021
④	Preparation of the Interim Report (IT/R)	work in Japan: Feb 2021

【The 3rd field work】 (the beginning of June, 2021 to the mid of July, 2021)

#	Item	Timing
①	Conducting field surveys: New target countries	field work: Jun–Jul 2021
②	PoC implementation support: phase 1 countries	field work: Jun–Jul 2021
③	Support for PoC implementation: brush-up of business model, implementation of demonstration	field work: Jun–Jul 2021

【The 4th work in Japan】 (the beginning of Aug, 2021 to the end of Mar, 2022)

#	Item	Timing
①	Compilation of field survey results	work in Japan: Aug 2021
②	Collaboration and handover the platform	work in Japan: Sep–Dec 2021
③	Preparation and presentation of Draft Final Report (DF/R)	work in Japan: Jan 2022
④	Preparation of Final Report (F/R)	work in Japan: Mar 2022

Figure 1-2　Project workflow

Source: JICA Survey Team

1.2.2 The Survey Team

The survey team consists of following members.

Table 1-1   Structure of the Survey Team

Name	Company	Position
Osamu Sakurai	Deloitte Touche Tohmatsu LLC	Team Leader/Building Platform
Minako Sagara	Deloitte Tohmatsu Venture Support Co., Ltd.	Open Innovation 1
Masayuki Sakata	Deloitte Touche Tohmatsu LLC	Open Innovation 2
Atsushi Tsukiyama	Deloitte Tohmatsu Venture Support Co., Ltd.	Open Innovation 3
Yoko Shibata	Deloitte Touche Tohmatsu LLC	Deputy for Building Platform/Open Innovation 4
Momoko Ishijima	Deloitte Touche Tohmatsu LLC	Digital Technology 1
Tatsuro Sazaki	Deloitte Touche Tohmatsu LLC	Digital Technology 2
Koki Nakayama	Deloitte Tohmatsu Venture Support Co., Ltd.	Digital Technology 3
Megumi Kii	Deloitte Touche Tohmatsu LLC	Digital Technology 4
Taro Watanabe	Deloitte Touche Tohmatsu LLC	Digital Technology 4
Tomonari Takeuchi	Deloitte Touche Tohmatsu LLC	Deputy for Building Platform/Digital Technology1 /Digital Technology 2

Source: JICA Survey Team

Chapter 2 Social and Peripheral Challenges in New Target Countries

2.1 Status of the Target Sector in the Target Country and Current Status of Digital Technology Utilization

JICA Survey Team collected basic information on the target sectors (below figure) in each of the new target countries, the current status of the use of various digital technologies that contribute to the resolution of issues, and international trends (including those of other donors) in STI field initiatives. Based on this information, we narrowed down the themes suitable for open innovation.
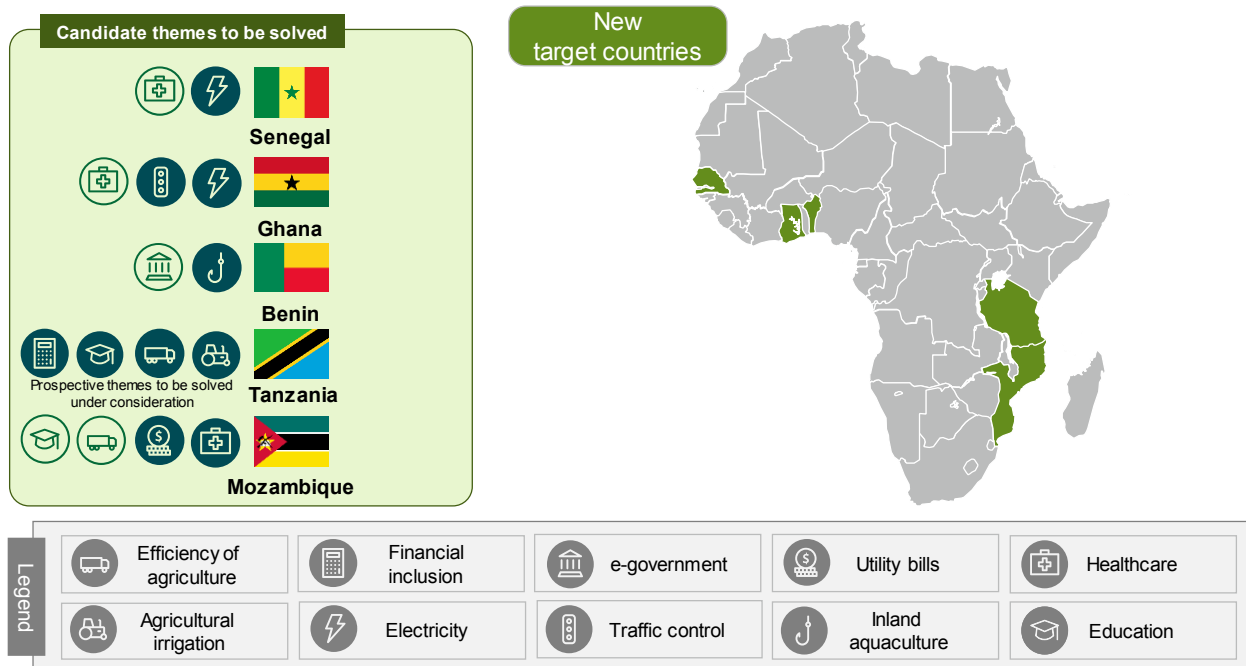
Figure 2-1   New Target Countries and Sectors

Source: JICA Survey Team

The series of research and analysis (identification of issues in each target country, innovation trends in the relevant fields, survey of local and domestic stakeholders, and narrowing down of themes) was conducted in accordance with the following.

➢ Identify the issues in each country and the assets that you can provide to solution providers.

➢ Analyze and organize the issues based on relevant reports of yours.

➢ Research on trends related to STI in other donors.

➢ Identify whether there are any examples of STI applications in the target fields in each target country, and if so, summarize them.

➢ Gather information on innovation trends in emerging, developing, target, and domestic countries related to the target field, as well as local and domestic stakeholders. For information on innovation trends and technologies, we conducted research using Tech Harbor, a unique platform owned by our group that allows users to search for information on startups and technologies around the world.

➢ Based on the aforementioned information, we developed a hypothesis for a new business proposal, mainly for the purpose of forming an ODA project, and organized the points where hypothesis verification is necessary.

➢ Interviews with large corporations, foundations, private funds, accelerators, etc. (e.g., Kopernik Japan, Kobe Institute of Information, VCs targeting African startups, trading companies, etc.) that are interested in solving social issues in developing countries to confirm the possibility of collaboration in open innovation (sponsorship, support for selected businesses and ideas).

➢ After organizing the above information, we will discuss with your task force members and local officials to narrow down the list to one or two themes per country that are suitable for open innovation.

The following is the details of the survey results for each new target country.

2.2   Ghana

2.2.1   Improving Efficiency in Traffic Demand Management and Planning

(1)   Current Status and Issues of Transport Sector

The Greater Accra Region, which includes the city of Accra,   is a major transportation hub in West Africa, where roads leading to the coastal and inland areas of the West African Growth Link intersect, and is the nexus of the Eastern Corridor and National Route 1 (Lagos-Abidjan Corridor) (as shown in below figure).
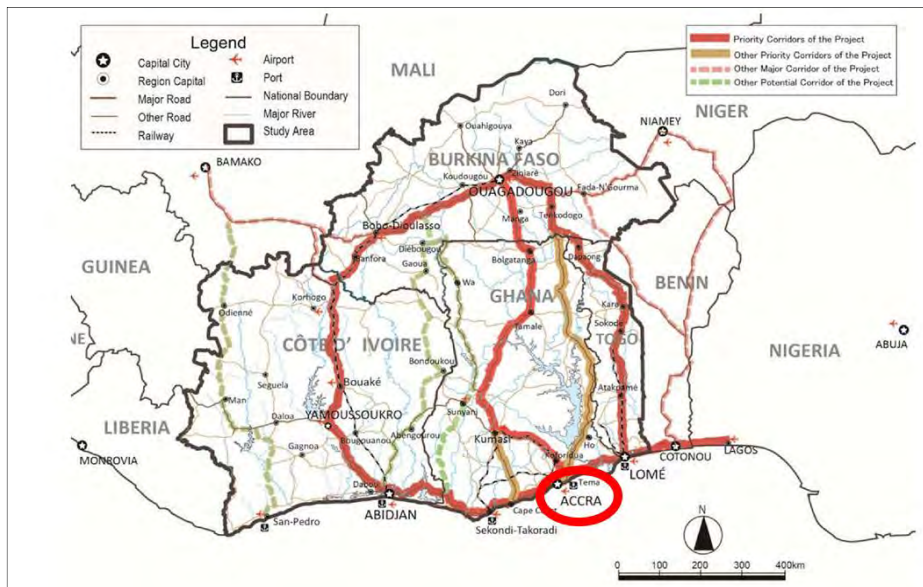
Source: THE PROJECT ON THE CORRIDOR DEVELOPMENT FOR WEST AFRICA GROWTH RING MASTER PLAN DRAFT FINAL REPORT 2017,7 JICA

Figure 2-2   Positioning of Ghana and Accra in the West Africa Growth Link

The following figure shows the road network of arterial roads in Ghana. Ghana relies on roads for 95% of passenger transportation and 90% of freight transportation. However, the pavement ratio on arterial roads is less than 50%, and 38% of the arterial roads are in an "inferiority" situation where the running performance deteriorates due to damage, etc.

Figure 2-3   Ghana and Accra Road Network

Source: The Project on the Corridor Development for West Africa Growth Ring Master Plan Final Report 2017.7 JICA

Due to the rapid population growth, the central urban area of Accra is experiencing chronic congestion that exceeds capacity. In the central urban area of Accra, there are many sections where the speed is 15 km/h or less in the morning and evening, and also there are many sections where the speed is 30 km/h or less on motorways that support intercity traffic.
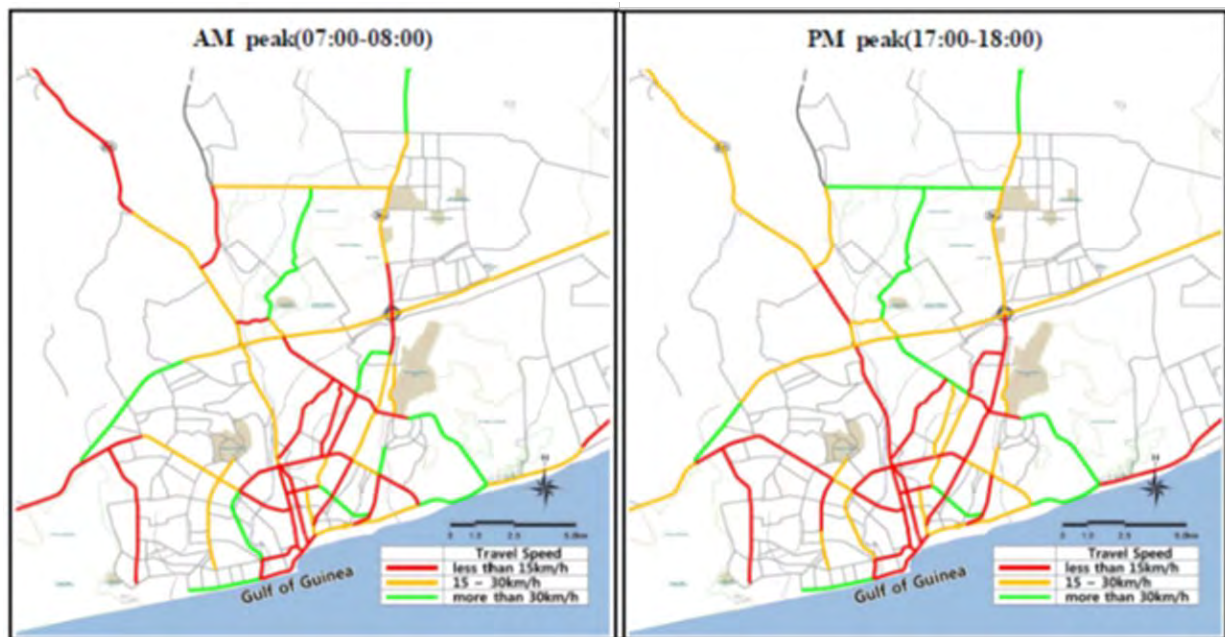
Figure 2-4   Travel speeds in central Accra

Source: Transportation Master Plan Greater Accra Region 2016 KOICA

Lack of coordination between ministries and agencies, inappropriate operation of public transportation systems, and lack of data and planning support tools to visualize traffic volume and road conditions make it difficult to formulate appropriate plans for improving traffic.
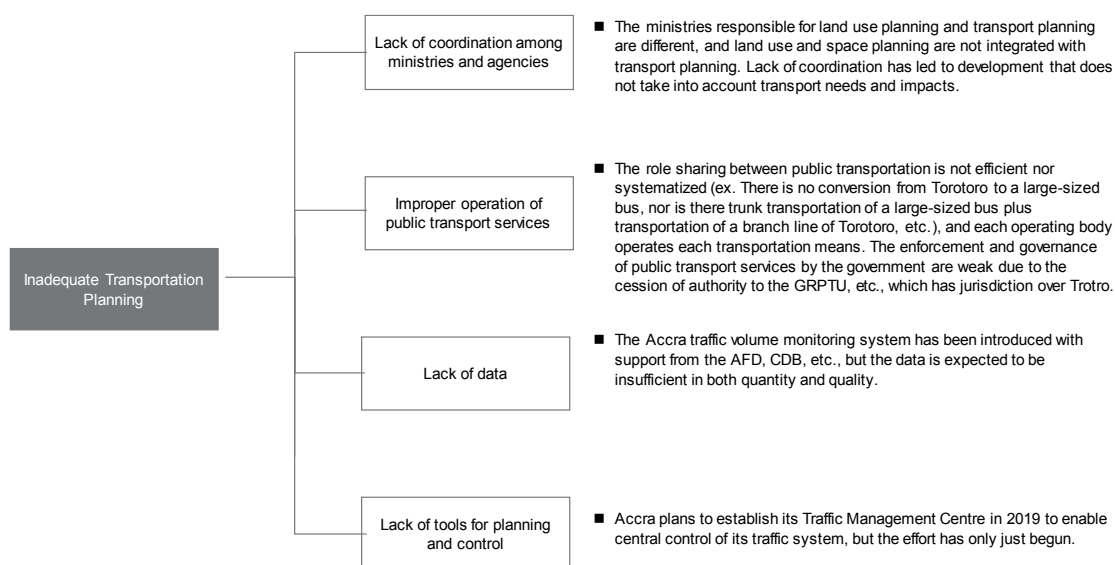
Figure 2-5　Issues in Planning

Land-use and transport plans are separated at the ministry level, and government governance of public transport services is weak due to the interests of various stakeholders. The following table shows the government agencies involved and their roles.

Table 2-1　Stakeholders Involved in Traffic Planning

Ministries and agencies and related organizations	Role
Ministry of Transportation	Responsible for the preparation, guidance, and dissemination of land, sea, and air transport plans and guidelines
Ministry of Road and Highways	Responsible for road policy planning
Ghana Highway Authority	Responsible for the planning, design, construction, and maintenance of national, interstate, and state highways
Department of Feeder Roads	Responsible for planning, designing, constructing, and maintaining local roads
Department of Urban Roads	Responsible for planning, designing, constructing, and maintaining urban roads
Ministry of Local Government, Rural Development and Environment	Responsible for local public transport
Ministry of Interior	Responsible for the transportation and transportation of automobiles
Ministry of Environment, Science, Technology and Innovation	Responsible for spatial planning at the national level, policy and guidelines for physical planning, and guidance and dissemination at the state and county levels
Local Assemblies (ex. Accra Metropolitan Assembly)	Responsible for issuing licenses to operators in the paratransit division
Ghana Private Road Transport Union (GPRTU)	A nationwide union that operates 90% of Torotoro and taxis in Japan
Ghana Road Transport Coordination Council (GRTCC)	An agency that represents the interests of road carriers in Ghana, including all carriers, and negotiates with the government on fares and vehicle acquisitions
Greater Accra Passenger Transport Executive (GAPTE)	A semigovernmental organization that operates bus services

(2)　Recent Co-operation by JICA and Other Donors

JICA has an extensive track record of cooperation in the infrastructure field, and its strong relationship with the MRH and the GHA, as well as National Route 8 as a testbed, are listed as assets.

Table 2-2   Recent Co-operation in Infrastructure

#	Deal Name	Scheme	Duration	C/P	Summary
1	Road Bridge Maintenance Project	Technical Cooperation	2019-2023	MRH	The aim is to improve the capacity of new construction, improvement and maintenance projects by revising the road and bridge maintenance manual and preparing the business management handbook.
2	The Project for the Rehabilitation of National Route 8, Phase II	Grant Aid	2018-	GHA	The improvement of the southern section of National Route 8 and the replacement of bridges in the Central Region will ensure smooth and safe road traffic on targeted roads, thereby contributing to the improvement of connectivity with major economic zones in Ghana and inland countries.
3	The Project for Improvement of the Ghana International Corridor	Grant Aid	2017-	GHA	A project to secure smooth and safe road traffic by improving the Tema intersection and renovating National Route 8 in the Central region, thereby contributing to the facilitation of logistics between international corridors (Lagos-Abidjan Corridor, Eastern Corridor, etc.)
4	Eastern Corridor Volta River Bridge Construction Project	Loan	2016-	GHA	The construction of a new bridge over the Volta River in the Eastern Corridor, which connects the largest port of Tema in Ghana and the Burkina Faso border Krung, will enhance transport capacity in the target area, thereby contributing to the revitalization of international logistics and the public interest between the northern and southern regions of Ghana and Burkina Faso.
5	Development Project of Bituminous Surface Treatment Method by LBT	Technical Cooperation	2016-2019	Provincial Highway Administration	Development of technical guidelines for labor-intensive simple paving (bituminous surface treatment) methods through trial construction, etc., which will contribute to efforts toward full-scale application
6	Strategic Master Plan Project for Development of the West African Growth Ring Corridor	Development Plan	2015-2018	West African Economic and Monetary Union Commission, Ghana MRH	Contributing to regional economic growth and increased private investment through the approval and commercialization of regional development strategies and plans that lead to balanced economic development in coastal and inland areas, thereby reducing regional disparities and improving logistics.
7	Kumashi Urban Area Comprehensive Development Project	Technical Cooperation	2011-2013	Urban and National Land Planning Bureau, Ministry of Environment, Science and Technology (at that time)	To promote urban development for the improvement of urban functions through the formulation of development strategy, spatial planning, land use planning and sector planning, selection of priority projects and formulation of external project implementation plans, and capacity building of the Urban and National Land Planning Bureau concerning urban development plans for the Greater Kumasi Urban Area until 2025, thereby contributing to the improvement of access to public services and the quality of public services in the Greater Kumasi Urban Area and the efficient and effective development of social infrastructure infrastructure.

Source: JICA Survey Team

CDB and AFD provide support in the area of transport planning (as in below table).

Table 2-3   Support from Other donors in the Field of Transport Planning

#	Donors, etc.	Deal Name	Duration	C/P	Summary
1	China Development Bank (CDB)	Acccra Intelligent Traffic Management System (AITMS)	2013-	Department of Urban Roads	Implemented as part of a loan from the CDB. Accra is equipped with smart signals that can communicate with each other.
2	Agence Francaise de Development (AFD)	Traffic Management Centre	2019-	Ministry of Road and Highways, Department of Urban Roads	A traffic control center (Traffic Management Centre) was established in Accra, and the Area-Wide Traffic Signal Control System (AWTSCS) was introduced to improve traffic conditions in the Accra city (USD 3.4 million). Traffic conditions are visualized in real time using intercommunicable signal data and detectors embedded in roads, and the traffic system in the capital is controlled centrally to improve traffic conditions in the city.

Source: JICA Survey Team

(3)   Applicability of Various Digital Technologies

The following figure illustrates the types of solutions that can be applied to the approachable issues and factors related to traffic demand management and planning. In Japan, many solutions are based on existing big data held by automobile companies, road companies, and telecommunications companies, etc. Therefore, we believe that a solution that involves data collection and output is appropriate for this initiative.

approachable issues and factors

- Lack of coordination among ministries and agencies
- Improper operation of public transport service
- Lack of data
- Lack of tools for planning and control

Solutions

1 Visualization of traffic conditions, supply and demand forecasts, and simulations
Example)Provision of congestion prediction information and optimal route information using traffic big data (GPS, driving data, etc.)
2D and 3D reproduction tools for pre-evaluation of infrastructure plans, optimization of signal placement and control, etc.

2 Optimization of public transportation
Example)Operation management tool for public transportation
Consulting support tools for road expansion and development plans utilizing know-how

3 Visualization of road conditions
Example)Road and other infrastructure inspections using cameras and drones
Grasp of road conditions using satellite data

Source: JICA Survey Team

Figure 2-6　Existing ICT Solutions

Below figure shows the companies and stakeholders that possess the corresponding technology/service for each type of solution.

Solutions

1 Visualization of traffic conditions, supply and demand forecasts, and simulations
Example)Provision of congestion prediction information and optimal route information using traffic big data (GPS, driving data, etc.), 2D and 3D reproduction tools for pre-evaluation of infrastructure plans, optimization of signal arrangement and control, etc.

2 Optimization of public transportation
Example)Operation management tool for public transportation
Consulting support tools for road expansion and development plans utilizing know-how

3 Visualization of road conditions
Example)Road and other infrastructure inspections using cameras and drones
Grasp of road conditions using satellite data

Stakeholders

Toyota Tsusho/Denso, Navi Time Japan, Hitachi, Ltd.
Nippon Signal/Nagoya Denki Kogyo, AnyLogic, NTT DATA, etc.

NEC, JRRI Information System, Zero Sum
Central consultants, Traffic Research Institute, etc.

Ricoh Co., Ltd., Kumonos Corporation, Iwane Research Institute
CLUE, Terra UTM, NEC, etc.

Figure 2-7　Examples of Stakeholders in Japan

Source: JICA Survey Team

We have summarized the information, including the name of companies, their services, and an outline of their advantage, of digital technologies which may contribute to improving the efficiency of transportation demand management and planning.**Example of ICT solutions (1)**

Ricoh has developed a technology to automatically visualize the degree of need for road repairs using cameras installed on ordinary vehicles.

Company Name	Ricoh Co., Ltd.	Service Overview	A service that automatically digitizes the degree of repair needed by photographing the road surface with a camera mounted on an ordinary car
head office	Tokyo, Japan		
Establishment	1936		
Number of Employees	slightly less than 10,000	superiority	✓ Because it can be used in ordinary vehicles, the cost can be significantly reduced compared to conventional dedicated vehicles (several hundred million yen), and detailed roads can be measured thoroughly.
investment stage	≒		✓ Automatic AI analysis of image data enables comprehensive evaluation of road maintenance management
deployment	Developing business in approximately 200 countries and regions worldwide (Africa is South Africa only.)		✓ Passed the performance verification test in Japan

Figure 2-8   Visualization of Road Conditions: Surveying and Maintenance Management Using Camera

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (2)

Teradrone is developing technology to achieve preventive maintenance of infrastructure structures and measurement of traffic volume by using cutting-edge technology.

Company Name	Terra drone Corporation	Service Overview	① Provision of infrastructure inspection services using drones
head office	Tokyo, Japan		② Development of Traffic Measurement Software Using Drones
Establishment	2016		
Number of Employees	≒	superiority	① The company's management tools can be used to manage information in the cloud and automatically convert three-dimensional terrain data.
investment stage	Capital: ¥299.75 million		② It can measure a wide range at a lower cost than a fixed point camera. AI-powered software enables the acquisition of a wide range of data, including vehicle and human speeds, driving trajectories, and traffic volume calculations for each vehicle type.
deployment	ODA projects in Indonesia and business development in South Africa		

Figure 2-9   Visualization of Road and Traffic Conditions: Using Drones to Inspect Infrastructure and Measure Traffic Volume

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (3)

NEC is developing technology that will enable the creation of smart bus systems through the advanced application of IoT and big data analysis.

NEC

	■ Introduction to Oman's state-run bus company
Example ①	✓ Visualization of real-time operation information on approximately 200 public buses in the capital city of Muscat (Management center and application users) and on-time operation support "Bus position information management system"
	✓ "Electronic toll collection system" which realizes accurate and reliable fare collection using a dedicated app

Company Name	NEC Corporation
Service Overview	One-stop operation management system through vehicle information and passenger information management utilizing electronic toll collection system and IoT (Indian Ahmedabad)
superiority	✓ Enables integrated implementation of the latest IoT solutions, optimized by region ✓ Implemented in several countries, mainly Asian countries including developing countries (Uki)

	■ Introduction to a route bus operating company in Pune, India
Example ②	✓ In addition to the above systems, various solutions are implemented, focusing on the following
	✓ "smart location information system" provides an integrated visual view of the operating conditions of more than 790 buses and 117 stations.
	✓ Based on real-time information, bus routes can be changed, schedules can be optimized, and occupants can be arranged "Vehicle planning and bus timetable formation system".

Figure 2-10   Introduction of Operation Management Tools and Know-How: Operation Management Tools for Public Transportation

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (4)

Navi-Time Japan has developed solutions that utilize various types of traffic big data as a device for visualization and simulation of traffic conditions.

Company Name	Navi Time Japan K.K.
head office	Tokyo, Japan
Establishment	2000
Number of Employees	–
investment stage	Capital 90 million yen
deployment	Expanding "transfer guidance service" for Free Use in Overseas Countries

Service Overview	A service that estimates accurate movement conditions from GPS data and returns analysis results combined with various road conditions/location information via an API.
superiority	✓ By simply transmitting GPS data, it is possible to analyze what kind of road/place, how fast and how often it passed, after correcting the position on the map. ✓ Results can be CSV output

Figure 2-11   GPS Based Location Analysis Solution

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (5)

Hitachi Group has developed solutions that utilize various types of traffic big data by applying cutting-edge technology as a service to visualize traffic conditions, forecast supply and demand, and conduct simulations.

Figure 2-12   Traffic Visualization Solutions Utilizing Cutting-Edge Technology

Source: JICA Survey Team based on the website of the company concerned

(4)   Potential OI themes

OI theme candidates in the transportation planning sector are organized as follows. Through discussion with JICA Ghana office, as PoC for IRI measurement utilizing iPhone is being implemented, no demand in the "improving the efficiency of road and bridge maintenance" was confirmed. As for "Improving efficiency in traffic demand management and planning", securing stakeholders that understands the challenge as well as PoC implementation structure are likely to become challenges in promoting OI.

Table 2-4   Theme setting in the area of transport planning

theme candidate	Whether there are related projects currently being implemented	Stakeholders	Diversity of solutions	potential outlet	Remarks
Improving efficiency in traffic demand management and planning	None	Mainly Japanese companies	〇	New technical cooperation, grant aid	・Need to confirm demarcation with AFD and CDB ・PoC in this survey is likely to be difficult
Improving the efficiency of road and bridge maintenance	Road Bridge Maintenance Project	Mainly Japanese companies	△?	Additional component in the existing project	・Measurement of IRI utilizing Iphone is ongoing in the left mentioned project

Source: JICA Survey Team

2.2.2 Improving health systems efficiency (maternal and child health)

(1) Current Status and Issues of Maternal and Child Health

Although MMR, NMR, and U5MR have shown gradual improvement in recent years, the mortality rate is still at a high level compared to countries with similar economic standards, and improvement of service quality is an urgent task. Although the MDG target was not achieved, there has been some improvement in the maternal mortality ratio (per 100,000 live births), decreasing from 484 to 308 between 2001 and 2017, but the mortality rate is still very high.
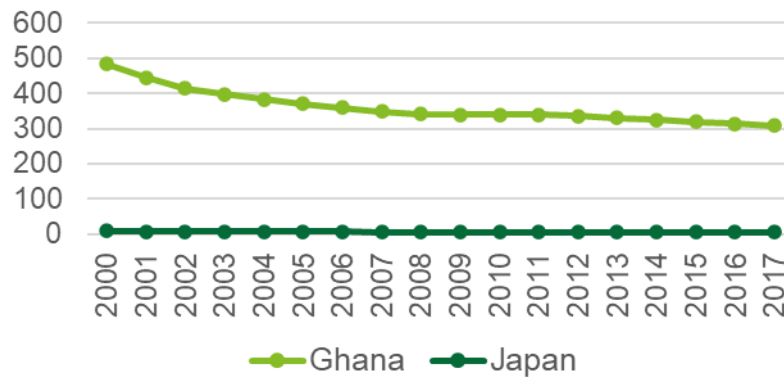
Figure 2-13   Maternal Mortality Rate

Source: Word Bank Data

Between 2000 and 2018, the neonatal mortality rate (1000 births) decreased from 36.2 to 23.9, and the under-5 mortality rate (1000 births) decreased from 99.5 to 47.9. However, there is still much room for improvement.
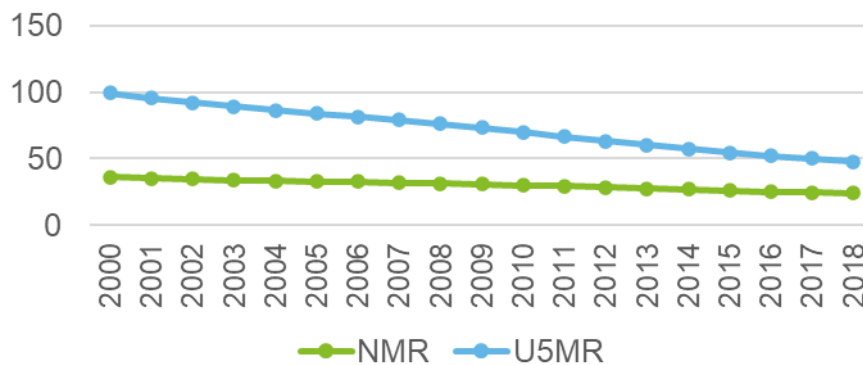
Figure 2-14   Trends in Neonatal and under-Five Mortality Rates

Source: Word Bank Data

Current status and issues of continuum of care for mother and child

Following figures indicate the status of maternal and child health coverage in terms of maternal health check-up rates, birth attendance rates by skilled birth attendants and postpartum care attendance rates (Source: Ghana Maternal Health Survey 2017). Bottlenecks include disparities in access to health care and poor service quality due to regional disparities in midwives and pediatrics.

➢   Percentage of pregnant women receiving health checkups (More than 4 times): 89% (2017)

- ➢ Rate of skilled birth attendants: 79% (2017)
- ➢ Postpartum care consultation rate (Within 48 hours after delivery): 84% (2017)

STI initiatives by the government of Ghana

The Government of Ghana established the National E-Health Strategy in July 2010 to digitize information from the ground up to the national level for data-driven planning. (Refer to Table 2-5 and Table 2-6.)

Table 2-5   Basic Policies on E-health

Year	typical policy	Contents
July, 2005	Health Sector ICT Policy and Strategy	―――
July, 2010	National E-Health Strategy	• Establishment of a regulatory framework for the management of information on health data, strengthening of human resources for e-health, utilization of m-health, telemedicine, and electronic messaging to bridge the service fairness gap, and establishment of four strategic pillars for computerization of records and reports

Source: JICA Survey Team

Table 2-6   Government Initiatives Related to ICT

Major Initiatives	Contents
DHIMS	• Health information system utilizing open resource system provided by Oslo University. Information such as service delivery information, disease information, equipment and facilities information, and health personnel information for each medical facility is input by county, and information is given to states and countries.
E-tracker	• Community health workers use tablets to input personal information about their services, including their mothers, which is automatically reflected in DHIMS. 2,950 tablets were donated by Samsung to the CHPS area in Volta, Upper East and Eastern states, and Good Neighbors International, a South Korean NGO, provides training for health workers in cooperation with the GHS.
CHPS Database	• Database containing information on CHPS equipment, infrastructure such as electricity and water, and information on health personnel
Lightwave e-health care services	• The National e-health strategy was launched in November 2017 to promote the introduction of an electronic medical record system, a patient management system, and an infectious disease surveillance system linked to insurance applications.
Adolescent Health App	• An application designed to improve the knowledge and skills of healthcare professionals who provide health care to youth, including policy documents, service standards and protocols, IEC materials, etc.

Source: JICA Survey Team

(2)   Recent co-operation by JICA and other donors

JICA promotes continuum of care for mother and child in Ghana under the EMBRACE model, has an extensive track record of cooperation in maternal and child health, and has strong relationships with GHS, Northern Province health facilities, and communities. The following table shows recent cooperation by in the health sector.

Table 2-7 Recent Co-operation in the Health Sector

#	Deal Name	Scheme	Duration	C/P	Summary
1	The Project for Strengthening Community Health Services Based on the Life Course Approach in Three Northern States	Technical Cooperation	2017-2021	GHS	The aim is to strengthen community health services based on the life-course approach by strengthening CHPS planning and implementation capacity, community activities, and governance in the three northern provinces, thereby improving the access and use of primary health care through CHPS and contributing to the achievement of universal health coverage.
2	Maternal and Child Continuum of Care Improvement Project through Maternal and Child Health Handbook	Technical Cooperation	2017-2020	GHS	The aim is for more mothers and children to use high-quality maternal and child health services, thereby contributing to the improvement of the completion rate of maternal and child continuum of care, through the nationwide distribution and training of methods of utilization of maternal and child health handbooks, integration of maternal and child health handbooks into existing health services through the institutionalization of maternal and child handbooks, and capacity building of health workers and mothers to make effective use of maternal and child health handbooks covering the six priority regions.
3	EMBRACE implementation study	Project Research	2012-2016	GHS	A research study that embodies the EMBRACE model, which recommends continuous and appropriate treatment and services from prenatal to postnatal, and aims to develop an effective package and establish a scientific basis for achieving maternal and child care.
4	The Project for Improvement of Community Health Facilities in Upper West Province	Grant Aid	2012-2016	GHS	The project aims to expand maternal and child health services in Upper West Region by constructing CHPS compounds and providing related equipment.
5	Project for Improving Maternal and Neonatal Insurance Services by Utilizing Local Health Functions in Upper West Province	Technical Cooperation	2011-2016	GHS	The objective of the project is to improve maternal and newborn child health services utilizing community health functions (CHPS) by improving the quality of prenatal, parturient and postpartum health services, improving the referral and consultation service system in maternal and newborn health services, strengthening the assisted supervision, and strengthening community participation in community health activities in Upper West Region.

Source: JICA Survey Team

International trends related to health ICT in Ghana are shown in below table.

Table 2-8 Donor Initiatives related to ICT

implementing agency	Major Initiatives	Duration	Contents
Savana Signatures	Technology for Maternal and Child Health	~ 2020 Phase 4	• SMS and voice messages are being sent to pregnant women, and community electronic health records are being introduced at pilot facilities in Northern, Upper East, and Borda provinces. T4 MCH Phase 4 is ongoing through April 2020.
The Grameen Foundation	MOTECH	-	• Provide timely health information to pregnant women and their families via SMS and voice messages on mobile phones. It also provides information to local community health organizations.
Novartis Foundation	Ghana Telemedicine Project	2011-2019	• Implementation of initiatives to connect local community health centers with doctors, midwives, and other specialists through a telephone center that provides 24 hour remote consultation
Sanford Health Enterprise (American non-profit organization)	Telemedicine and Integrated ICT System for Health	(2014)-2020	• Operating more than 360 clinics with 19 real-time telemedicine, offline image sharing and electronic medical record systems

Source: JICA Survey Team

（3） Applicability of Various Digital Technologies

Challenges related to the health system (maternal and child health) can be organized according to the time axis from pre-pregnancy to postnatal. The following figure illustrates the solutions which may contribute to improving the efficiency of the health system by health system component as well as time axis

		Pre-pregnancy	During pregnancy	At the time of delivery	postnatal (nPwborn)	Postnatal (Under 5 years old)
1	Service	telemedicine				
		mobile devices			mobile devices	
			wearable		wearable	
			ambulance dispatch service			
		nutritional foods (complete feeding, insect nutrition, etc.)				
2	Health workforce	AI diagnostic aid				
		information platform for medical institutions and employees				
3	health information	Information platform for mothers				
			computerization of maternal and child handbook			
4	Pharmaceuticals medical technology, etc.	improving inventory management efficiency (purchase of inventories, etc.)		blood and pharmaceutical products drone delivery	improving inventory management efficiency (purchase of inventories, etc.)	
		home medication			home medication	
5	Health financing	microinsurance service				
6	Leadership governance	policy-related (push notification of media, subsidies, etc.)				

Figure 2-15　Existing ICT Solutions

Source: JICA Survey Team

The following is a list of domestic and overseas companies and stakeholders that possess the corresponding technologies and services for each type of solution.

	Solutions	Stakeholders	
		Domestic	Overseas
1	Service Delivery — Example)Telemedicine and mobile medical care, nutritional foods, simple health checkups, blood drone delivery, wearables, ambulance dispatch services, etc.	Melody International, Lequio Power Technology, Agree, Cancerscan, CureApp, YUKASHIKADO, Euglena, etc.	Babylon Health, tinyDAVID, Life Spring Hospital, Neopenda, etc.
2	Health Workforce — Example)AI diagnostic aids, services for medical institutions and employees, etc.	miup, Ubie, etc.	Ubenwa Intelligence Solutions, etc.
3	Health Information — Example)Information platforms for mothers, maternal and child health handbooks, etc.	NTT/FUJITSU, Softbank, Antaa, etc.	Babymigo, GiftedMom Mahmee, Helpmum, Totohealth, etc.
4	Pharmaceuticals and Medical Technology — Example)Placing agents, simple hemostatic agents, etc.	Terra drone, Eneforest, etc.	Zipline, mPhama, Axio Biosolutions, etc.
5	Health Financing — Example)Small Amount Insurance Services, etc.	Rakuten, etc.	Jamii Africa, Pineapple, etc.

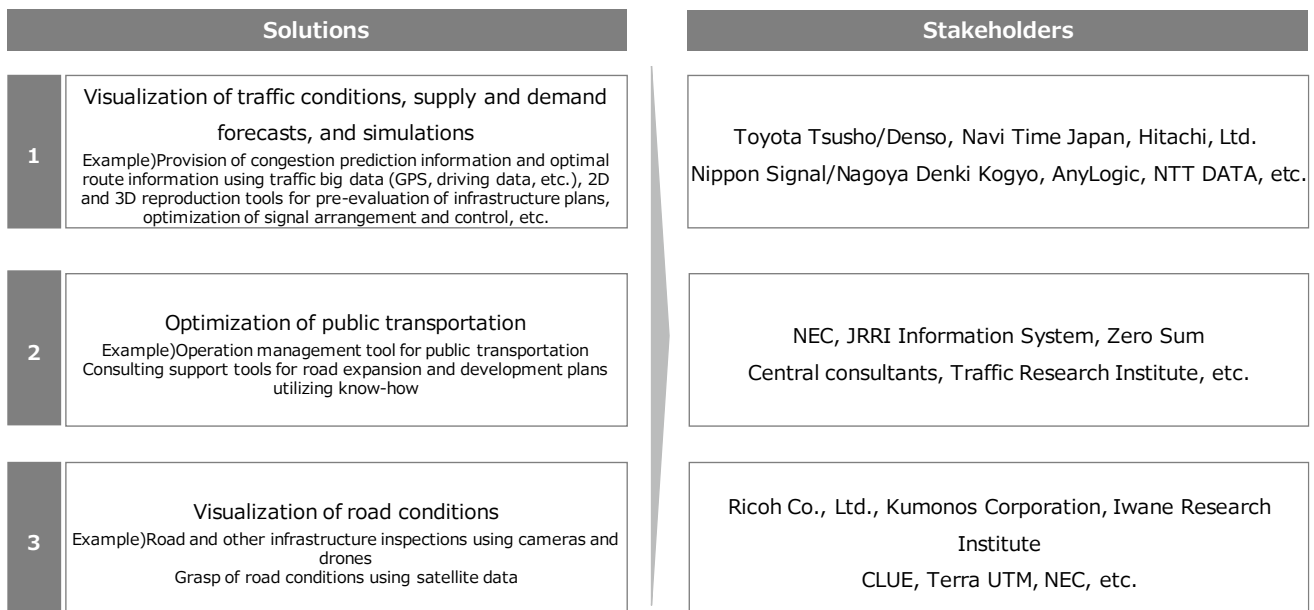**Figure 2-16　Solution Provider**

Source: JICA Survey Team

We have summarized the information, including the name of companies, their services, and an outline of their advantage, of digital technologies which may contribute to the efficiency of the health system (maternal and child health).

Example of ICT solutions (1)

Babylon Health has developed a medical diagnosis service using AI chatbots with the aim of creating a world where everyone in the world can receive affordable medical services.

Company Name	Babylon Health (In Rwanda, babyl)
head office	United Kingdom
Establishment	2013
Number of Employees	1001 -5000 people
investment stage	Series B $85.3 M (Approx. ¥9.4 billion)
deployment	Currently operating in the UK and Rwanda with plans to expand to China, the US and the Middle East

Service Overview	AI chatbot for medical diagnostics • Video-Call with Physician, Healthcare Reservations • Inspection code can be received and inspected by partner institutions • You can pick up your medication at a nearby pharmacy.
superiority	✓ Covering 30% (More than 2 million) of the target population (16 years of age or older) in Rwanda ✓ 4500 visits per day ✓ USSD compatible

Figure 2-17　Telemedicine and mobile medical services

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (2)-1

Melody International has developed a mobile device that aims to build a communication platform for pregnant women and doctors around the world.

Company Name	Melody International Co., Ltd.
head office	Kagawa Prefecture, Japan
Establishment	2015
Number of Employees	Four.
investment stage	Capital: approximately ¥107 million
deployment	JICA's Grassroots Technical Cooperation Project: Thailand, Jump Out Japan! (Ministry of Economy, Trade and Industry) has a track record of business development in South Africa

Service Overview	✓ Development of Japan's first IoT fetal monitor "Delivery monitoring device iCTG" and perinatal telemedicine platform "Melodii" to provide telemedicine systems
superiority	✓ By using the above system, we will build a communication platform that can receive advice from doctors even in areas with a shortage of doctors. ✓ Developing businesses in Africa and other developing countries

Figure 2-18　Mobile Device for Communication between Pregnant Women and Doctors

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (2)-2

Lequio Power Technology has developed mobile devices (ultrasound diagnostic imaging system) with the aim of filling the blank area of medical services in the world with innovative medical devices and information technology.
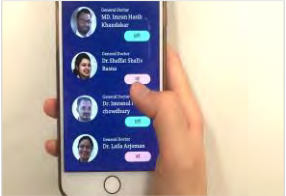
Company Name	Recio Power Technology Co., Ltd.
head office	Okinawa Prefecture, Japan
Establishment	2011
Number of Employees	Four.
investment stage	Series B common stock: approximately ¥125 million
deployment	After implementing a medical care project in Sudan, business is expanded mainly in Kenya and Africa.

Service Overview	Development of Ultrasound Imaging Devices in Developing Countries with Limited Access to Medical Devices
superiority	✓ Low-cost, low-power products designed for developing countries ✓ With a weight of 170 g to 270 g, it is excellent in portability, and the battery can be charged from a PC, and it can be used even in unstable electric conditions. ✓ Adoption of J-Startup in 2018 and JICA in 2015

Figure 2-19   Development of mobile devices (ultrasound imaging devices)

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (3)

Miup is developing a system of AI diagnostic assistance based on a large amount of vital data, with the aim of building a worldwide ecosystem of health management, diagnostic assistance, and disease prevention.

Company Name	miup Inc.
Head office	Tokyo, Japan
Establishment	2015
Number of Employees	-
Investment stage	-
Deployment	Developing in Bangladesh

Service Overview	Providing telemedicine and medical examination services using AI technology and other ICT, mainly in developing countries
Superiority	✓ In addition to providing telemedicine and medical examination services in urban areas, the company constructing a simple medical examination and interview result identification system using AI that can be provided to people with difficult medical access. ✓ Under JICA SDGs Project, the company develped AI Screening and Remote Diagnosis Support System for the Poor

Figure 2-20   ICT-Based Telemedicine and Medical Examination Service

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (4)-1

GiftedMom is developing an information platform (app) for mothers, aiming to reduce the maternal and child mortality rate in remote areas through using the latest technology.
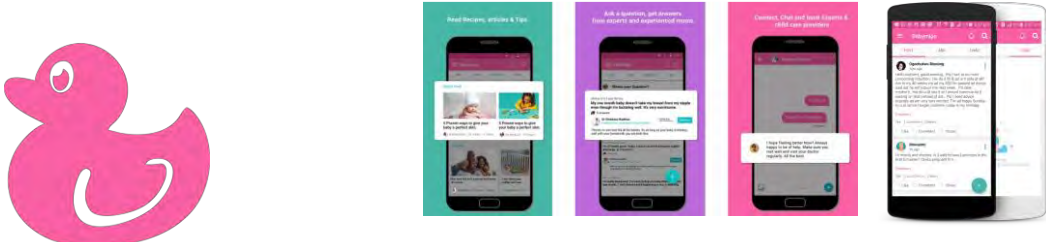
Company Name	GiftedMom		Service Overview	Providing a (From before to after delivery) health information platform for mothers
head office	Cameroon			
Establishment	2013			
Number of Employees	-		superiority	✓ Build an SMS notification and voice-based education platform that can be used in low-literacy areas ✓ Once you pay a fixed registration fee (Less than or equal to 1 $), you can receive messages such as notification of vaccination timing for free. ✓ Even in rural areas, apps can provide maps and location details and call medical cars
investment stage	-			
deployment	Business development centered on Cameroon			

Figure 2-21 Health Information Platform

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (4)-2

Babymigo is building a mutual-help information platform (for mothers) in areas where there is no access to doctors.

Company Name	babymigo		Service Overview	Providing a platform for obtaining various information necessary for childbirth and child rearing before delivery
head office	Nigeria			
Establishment	2017			
Number of Employees	–		superiority	✓ Search for pregnant women living nearby and parents raising children, and create a community of mothers and fathers who can easily consult with each other. ✓ More than 90,000 users, primarily in Nigeria
investment stage	–			
deployment	Focusing on Nigeria			

Figure 2-22 Information Platform for Mothers

Source: JICA Survey Team based on the website of the company concerned

Examples of ICT solutions (4)-3

NTT Docomo and Fujitsu has developed a system that allows expectant and nursing mothers to centrally manage and check the results of their own medical examinations. (digitalization of the maternal and child health handbook and linkage with medical records in hospitals).

Company Name	NTT DOCOMO X Fujitsu Co., Ltd.
head office	Japan
Establishment	Launched on April 1, 2019
Number of Employees	-
investment stage	-
deployment	Implemented in Tokyo, Shizuoka, Ehime, etc.

Service Overview	Sales of "Prenatal checkup result reference service" linking DOCOMO's "Maternal and Child Health Handbook Application" with electronic medical records and Fujitsu's healthcare information infrastructure to medical institutions
superiority	✓ You can manage your own medical information and echo images, and check comments and advice from doctors without going to the hospital. ✓ Business model that can be paid by medical institutions and used for free by pregnant women

Figure 2-23   Digitalization Service to Link Maternal and Child Health Handbook to Electronic Medical Records in Hospitals

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (4)-4

Softbank is developing and providing services that enable proactive support by recording and managing health information from infancy through life. (digitization of maternal and child health handbook and linkage with medical records in hospitals)

Company Name	Softbank Corporation
head office	Japan
Establishment	Service launched in 2017
Number of Employees	-
investment stage	-
deployment	It has been introduced in Ikeda City, Osaka Prefecture, Niimi City, Okayama Prefecture, and Anpei Town, Hokkaido.

Service Overview	Provide local governments with a "growth log service" that records and manages growth and development information from infancy to promote lifelong health support through maternal and child health handbooks.
superiority	✓ Provide seamless support by providing information tailored to each stage of life, including information on vaccinations, health checkups, and events ✓ Encouraging appropriate contacts and preventing isolation through personalized information dissemination and family sharing ✓ Residents' attribute information and request function enable the development of services tailored to local issues

Figure 2-24   Growth log service to link maternal and child health handbook to electronic medical records in hospitals

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (5)

Zipline International has developed drone delivery of blood and medicines with the aim of providing immediate access to essential medicines to all humans in the world.

Company Name	Zipline International Inc.
head office	State of California, U.S.A.
Establishment	2014
Number of Employees	101 -250 people
investment stage	Series C $233 M (Approximately 100 million yen)
deployment	Currently operating in Rwanda and Ghana with plans to expand throughout Africa, the United States, Southeast Asia and South Asia

Service Overview	GPS Drone Delivers Blood Products to Medical Institutions
superiority	✓ It took 4 hours by car to deliver blood products to a hospital in a remote area in 15 minutes. ✓ Africa's Latest Unicorn in Early 2019 ✓ River innovation to the United States

Figure 2-25   Drone delivers blood and medicines

Source: JICA Survey Team based on the website of the company concerned

(4)   Potential OI themes

In the health sector, potential themes include strengthening awareness of pregnant women and mothers, assuming an ODA project formulation as exit, or improving the quality of healthcare services assuming private business formulation as exit.

Table 2-9   Theme candidate in the area of health system efficiency (maternal and child health)

theme candidate	Whether there are related projects currently being implemented	Stakeholders	Diversity of solutions	potential outlet	Remarks
Improving the quality of healthcare service	・Project for Improving Maternal and Child Health Services through Maternal and Child Health Handbook ・The Project for Strengthening Community Health Services Based on the Life Course Approach in Three Northern States	Japanese and local companies (under investigation)	○	・Additional component in existing technical cooperation project ・Private business	
Strengthening awareness of pregnant women	・Project for Improving Maternal and Child Health Services through Maternal and Child Health Handbook	Japanese and local companies (under investigation)	△	Additional component in existing technical cooperation project	Grameen Foundation had been providing SMS and sound information service for pregnant women and mothers

Source: JICA Survey Team

2.2.3　Electrification of unelectrified areas

(1)　Applicability of various digital technologies

Regarding electrification of unelectrified areas, for which JICA Ghana office expressed additional interest, we have summarized the information, including the name of companies, their services, and an outline of their advantage, of digital technologies which may contribute to solving the issues.

Example of ICT solutions (1)

WASSHA is developing an off-grid electricity supply service on a pay-as-you-go basis, with the aim of providing electricity service to unelectrified areas.

Company Name	WASSHA Corporation		Service Overview	Providing power services to people in unelectrified areas using IoT technology
head office	Tokyo, Japan			
Establishment	2013			
Number of Employees	160 people		superiority	✓ The combination of "digital grid technology" and "mobile money" enables remote management of maintenance and billing, as well as power control
investment stage	Cumulative total of Series B is approximately 2.4 billion yen			✓ Based on the above, we have established a franchise model and assigned local staff to deal with problems.
Remarks	Currently developing business mainly in Tanzania. There is a local base.			

Figure 2-26　Power control and remote management of maintenance and billing

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (2)

M-Kopa is developing a pay-as-you-go solar system in order to provide electricity service to unelectrified areas.

Company Name	M-Kopa
head office	Kenya
Establishment	2011
Number of Employees	251-500
investment stage	$161.8 million (Approx. ¥17.7 billion)
Remarks	Mitsui & Co., Sumitomo Corp. Invested

Service Overview	A pay-as-you-go solar system that combines solar panels with home appliances such as televisions and radios
superiority	✓ Providing electricity to more than 600,000 homes in rural areas with no electricity ✓ Enables installment sales combining IoT and mobile payment technologies ✓ Developing business with a view to utilizing electricity consumption and payment data

Figure 2-27   Pay-as-you-go solar system

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (3)

Mobisol Group is developing and supplying off-grid electricity on a pay-as-you-go basis to realize the provision of electricity services to unelectrified areas.

Company Name	Mobisol Group
head office	Germany
Establishment	2010
Number of Employees	51-100
investment stage	$1M -10 M (Approx. ¥11 billion -110 billion)
Remarks	–

Service Overview	A pay-as-you-go solar system that combines solar panels with home appliances such as televisions and radios
superiority	✓ More than 425,000 people have access to electricity ✓ More than 85,000 systems have been installed across East Africa

Figure 2-28   Pay-as-you-go off-grid electricity

Source: JICA Survey Team based on the website of the company concerned

⑵　Potential OI themes

The electrification of non-electrified areas is a field where private investment is easy to enter and promising ventures have already been visualized, so the need to implement OI is low.

Figure 2-29　Theme setting in the electric power sector

<div align="right">Source: JICA Survey Team</div>

2.3　Senegal

2.3.1　Making health systems more efficient

⑴　Current status and challenges in healthcare system

About current situation of the healthcare system in Senegal, the following table shows the main challenges with a framework for functions and elements of healthcare system commonly used for Universal Health Coverage (UHC), which is one of the pillars for the Japanese ODA in Senegal for healthcare area.

Table 2-10　Main Challenges in Achieving UHC

Healthcare Financing	Health and Medical Services/Human Resources/Health Information/Pharmaceuticals and Medical Devices	
	demand side	supply side
■ **Increase in income** ✓ Securing financial resources through taxes (paid by government) ✓ Increase in Number of Insurance Subscribers (paid by pacients) ✓ Ensuring donor support *In 2015, the Universal Health Protection Coverage Agency was established, and expanding the community health insurance system, particularly to improve economic access to health services for the poorest as a national priority. However, the Ministry of Health and Social Action, in particular the Universal Health Protection Coverage Agency, lacks the budget to promote the spread of the medical security system, in particular, the health insurance of the poorest people, who are fully subsidized by the government for their own health insurance premiums and medical expenses. ■ **Expenditure Efficiency** ✓ Development of investment plans in the health sector ✓ Efficient implementation of the plan ✓ System for checking the status of implementation ✓ Evaluation scheme and system	■ **Improved economic access** ✓ Expansion of the medical security system *68% of the poor (20% of the lowest income distribution) cited economic reasons as impediments to access to maternal and child health services, indicating that they cannot access health services at affordable costs * 1 *While the Senegal government is expanding health insurance schemes for the informal sector, including the poorest, and free health care for pregnant women and children under 5 years of age, the coverage of these schemes remains at 32.6% of the population * 2. *As of 2015, the maternal mortality rate per 100,000 live births was 315, a significant gap from the target of 127, and a significant gap between regions and between economic levels * 3	■ **Improved physical access** □ **Increased volume of services** ✓ Elimination of shortage of medical personnel *The number of physicians (0.6 employees) and nurses and midwives (4.2 employees) per 10,000 population is well below the regional average for Africa (2.7 persons and 12.4 persons, respectively) and the WHO recommended level (Number of doctors, nurses and midwives: 22.8) * 4. ✓ Elimination of shortage of medical facilities *The number of hospitals (0.2) per 100,000 population is also below the regional average for Africa (0.8) * 4 ✓ Elimination of shortages of medical devices and drugs □ **Improvement of service quality** ✓ Providing safe and secure services *Poor motivation of health staff and poor service quality are also among the reasons for poor health indicators * 5 □ **Elimination of regional disparities** *Because many of the medical facilities and personnel are concentrated in the Tokyo metropolitan area, regional disparities are also large. Only 2 of 14 states meet the WHO recommendations for medical facilities (1 hospital per 300,000 population) * 6

Source: *1: 2011, State Demographic Department, 2: 2016, JICA Survey, 3: 2015, World Bank, 4: 2013, WHO, 5: Senegal "National Health Development Plan (PNDS 1998 -2007)", 6: 2010, Ministry of Health and Social Action of Senegal

There are various private stakeholders in the fields of medical insurance and continuous care for mother and child. As an example, Japanese companies are shown in the table. It is not confirmed that these companies are operating in Senegal.

Table 2-11　Stakeholders Related to Maternal and Child Care and Health Insurance

Organization Name	Outline and Roles
Ministry of Health and Social Action	Ministries in charge of health care
Medical Security Administration	Ministries responsible for SIGICMU
National Institute for Health and Social Development	The only national paramedical training school that Japan has supported with technical cooperation and grant aid
State Medical Office	State health department (Assumes Pressmn directly intervening states, etc.)
World Bank	Support for improving the quality of health and nutrition services for pregnant women and newborns, etc., and support for the development of SIGICMU
AFD France	Support for improvement of maternal and child health and development of SIGICMU
Melody International Co., Ltd.	Development of Japan's first IoT fetal monitor "Delivery monitoring device iCTG" and perinatal telemedicine platform "Melodii" to provide telemedicine systems
miup Inc.	Providing telemedicine and medical examination services using AI technology and other ICT, mainly in developing countries
Lequio Power Technology Co., Ltd.	Developed ultrasound imaging devices for Developing Countries with limited access to medical devices

Source: JICA Survey Team

(2)　Recent cooperation by JICA and other donors

In Senegal, JICA has been providing comprehensive support using various schemes to achieve UHC, and has strong relationships with central and local government health departments. Below table shows recent cooperation by JICA.

Table 2-12   JICA's Assistance in the Field of Health Care

#	Deal Name	Scheme	Duration	C/P	Summary
1	Universal Health Coverage Support Program	Loan	2016-	Ministry of Economy, Finance and Planning	In order to achieve universal health coverage in Senegal, Japan will expand economic and physical access to health and medical services, mainly for the poorest people, in collaboration with the World Bank, and thereby contribute to the improvement of basic social services, by promoting: (a) formulation of health financing strategies, related investment plans and securing government budgets; (b) revision of medical security system-related manuals; and (c) formulation of strategies for increasing the quantity and quality of health and medical services, including maternal and child health.
2	Project to Strengthen Maternal and Neonatal Healthcare(PRESSMN) Phase 1 ~ 3	Technical Cooperation Project	2009-11 2012-18 2019-24	Ministry of Health and Social Action	Based on Japan's midwifery care that draws out the natural power of mothers and children, the project will work to form a "PRESSMN Model" that emphasizes "respectful maternal and neonatal care" that can be practiced through the cooperation of health and medical facilities, administration, and communities, even in rural areas where there are few specialists, which eventually contributes to the reduction of neonatal mortality.
3	Strengthening of Management of Health System Phase 1 and 2	Technical Cooperation Project	2011-14 2016-21	Ministry of Health and Social Action	Deploying various package management tools in direct intervening states, the project builds results-based management capacity in health services in Senegal by supporting further scale-up and development of a national deployment strategy to help improve coverage and quality of health services in Senegal.
4	Project for Strengthening Capacity of Community Health Insurance System and Free Health Care Initiatives	Technical Cooperation Project	2017-21	Universal Health Protection Coverage Agency(Ministry of Health and Social Action)	The program aims to strengthen the community health insurance system and free medical care system for the socially vulnerable, especially the poor, infants, expectant mothers and infants, and to support the achievement of UHC in Senegal, through capacity building through training, monitoring and provision of equipment to the Universal Health Protection Coverage Agency, health mutual aid associations and medical institutions that operate these systems.
5	Project for Construction of the Practical Training Center for Maternal and Child Health in National School of Health and Social Development	Grant	2014-	Ministry of Health and Social Action	The expansion of the maternal and child health practical training building of a public health personnel training school in capital Dakar, which is responsible for training nurses, midwives, etc., also functions as a place for education on "PRESSMN model".

Source: JICA Survey Team

As shown in following table, in Senegal, various donors are providing assistance in the field of health and medical care, and it is necessary to establish an OI based on these existing cooperation

Table 2-13   ICT-Related Support from Other Donors in the Health Care Sector

#	Donors, etc.	Deal Name	Duration	Summary
1	World Bank	Health and Nutrition Financing Project	2014-18	A project of assistance designed to improve the quality and use of health and nutrition services for pregnant women, newborns and young children in the poorest parts of Senegal. Financial support to a supply side that have introduced performance-based payment, and support to a demand side through capacity building of medical security institutions
2	United Nations, the World Bank Group, the Government of Canada, the Government of Norway, and the Government of the United States	Global Financing Facility (GFF)	Unknown	Efforts to raise the necessary funds in the capital markets for countries that are significantly short of funds for the improvement of "reproductive, maternal, newborn, child and adolescent health (RMNCAH)"
3	USAID	Health Systems Strengthening (HSS) Program	2011-16	A project targeting performance-based payments in six regions of Senegal, helping improve health services, establish health mutual aid associations, and strengthen its operational capacity
4	USAID	Health Systems Strengthening (HSS) Program + (plus)	2016-	Based on the above mentioned project, this project will further strengthen health governance and finance, community-level engagement in health system management, health information systems, and direct finance for health-enhancing areas.
5	AFD	Improving Maternal and Child Health in Three Regions of Senegal	2019-23	While Senegal's health sector has been developing over the last 10 years, maternal and neonatal mortality rates have shown little improvement. In addition to financial assistance, support will be provided to the Senegalese local government for governance and human resource development.
6	AFD	Improving Access to Health for Children under Age Five	2014-18	Part of the French Sahel Partnership Action Plan (13 IS) for countries that are actively pursuing policies to build systems to improve children's access to health systems

Source: JICA Survey Team

(3)   Applicability of various digital technologies

i)   Continuum of care for mother and child

In below figure, the challenges related to the health system (continuum of maternal and child) can be categorized with the horizontqal axes of stages among pregnancy, delivery, and postnatal and with the vertical axes of elements of healthcare system.　The solutions corresponding to these challenges are shown in the below Figure.
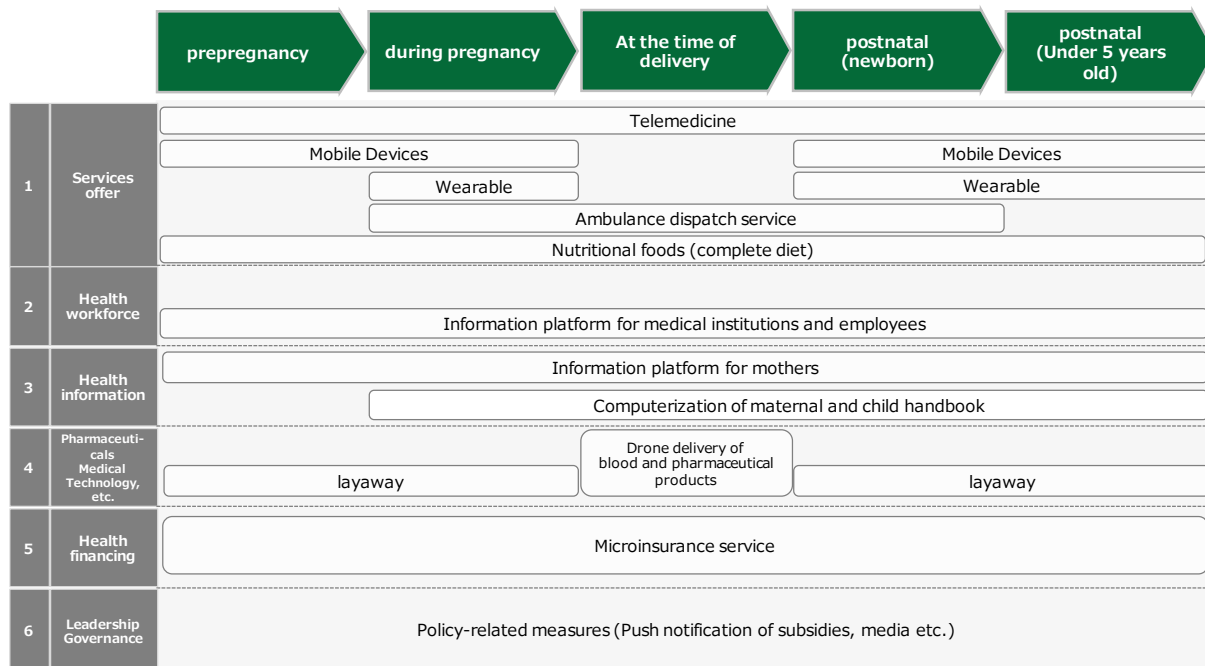
Figure 2-30　Existing ICT Solutions

We have summarized the information, including the name of companies, their services, and an outline of their advantage, of digital technologies which may contribute to improving the efficiency of continuum of care for mother and child as follows.

Example of ICT solutions (1)

Melody International has developed a mobile device that aims to build a communication platform for pregnant women and doctors around the world.

Company Name	Melody International Co., Ltd.
Head office	Kagawa Prefecture, Japan
Establishment	2015
Number of Employees	Five
Investment stage	Capital: approximately ¥107 million
Deployment	JICA's Grassroots Technical Cooperation Project (Thailand), Jump Out Japan! By Ministry of Economy, Trade and Industry (South Africa)

Service Overview	✓ Development of Japan's first IoT fetal monitor "Delivery monitoring device iCTG" and perinatal telemedicine platform "Melodii" to provide telemedicine systems
Superiority	✓ By utilizing the above system, the company has created a communication platform that enables pregnant women in areas with a shortage of doctors to receive simple diagnoses and advice from doctors. ✓ Developing businesses in Africa and other developing countries

Figure 2-31　Mobile device for communication between pregnant women and doctors

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (2)

Lequio Power Technology has developed mobile devices (ultrasound diagnostic imaging system) with the aim of filling the blank area of medical services in the world with innovative medical devices and information technology.

Company Name	Lequio Power Technology Co., Ltd.
head office	Okinawa Prefecture, Japan
Establishment	2011
Number of Employees	10 employees
investment stage	Series B Capital: approximately ¥125 million
deployment	After implementing a medical care project in Sudan, business is expanded mainly in Africa including Kenya.

Service Overview	Development of Ultrasound Imaging Devices in developing countries with limited access to medical devices
superiority	✓ Develop low-cost, low-power products designed for developing countries ✓ With a weight of 170 g to 270 g, it is excellent in portability, and the battery can be charged from a PC, and it can be used even in unstable electric conditions. ✓ Adoption of J-Startup in 2018 and of JICA program in 2015

Figure 2-32　Development of mobile devices (ultrasound imaging devices)

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (3)

Miup is developing a system of AI diagnostic assistance based on a large amount of vital data, with the aim of building a worldwide ecosystem of health management, diagnostic assistance, and disease prevention.

Company Name	miup Inc.
Head office	Tokyo, Japan
Establishment	2015
Number of Employees	-
Investment stage	-
Deployment	Developing in Bangladesh

Service Overview	Providing telemedicine and medical examination services using AI technology and other ICT, mainly in developing countries
Superiority	✓ In addition to providing telemedicine and medical examination services in urban areas, the company constructing a simple medical examination and interview result identification system using AI that can be provided to people with difficult medical access. ✓ Under JICA SDGs Project, the company develped AI Screening and Remote Diagnosis Support System for the Poor
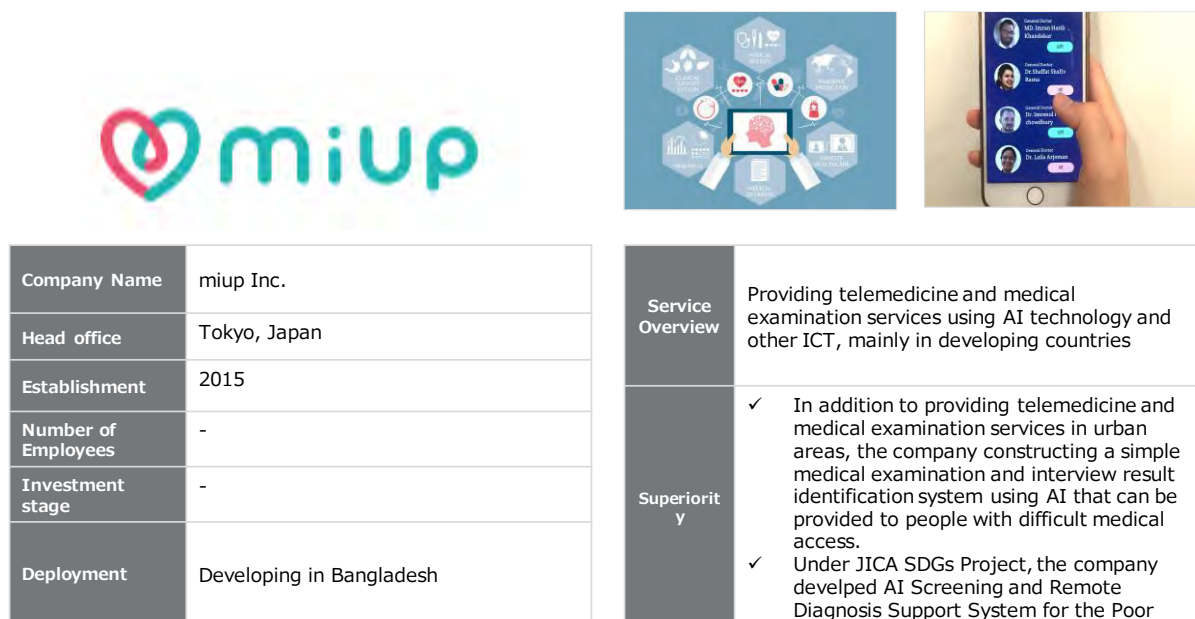
Figure 2-33   ICT-based telemedicine and medical examination service

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (4)-1

GiftedMom is developing an information platform (app) for mothers, aiming to reduce the maternal and child mortality rate in remote areas through using the latest technology.

Company Name	GiftedMom
head office	Cameroon
Establishment	2013
Number of Employees	-
investment stage	-
deployment	Business development centered on Cameroon

Service Overview	Providing a (From before to after delivery) health information platform for mothers
superiority	✓ Build an SMS notification and voice-based education platform that can be used in low-literacy areas ✓ Once you pay a fixed registration fee (Less than or equal to 1 $), you can receive messages such as notification of vaccination timing for free. ✓ Even in rural areas, apps can provide maps and location details and call medical cars
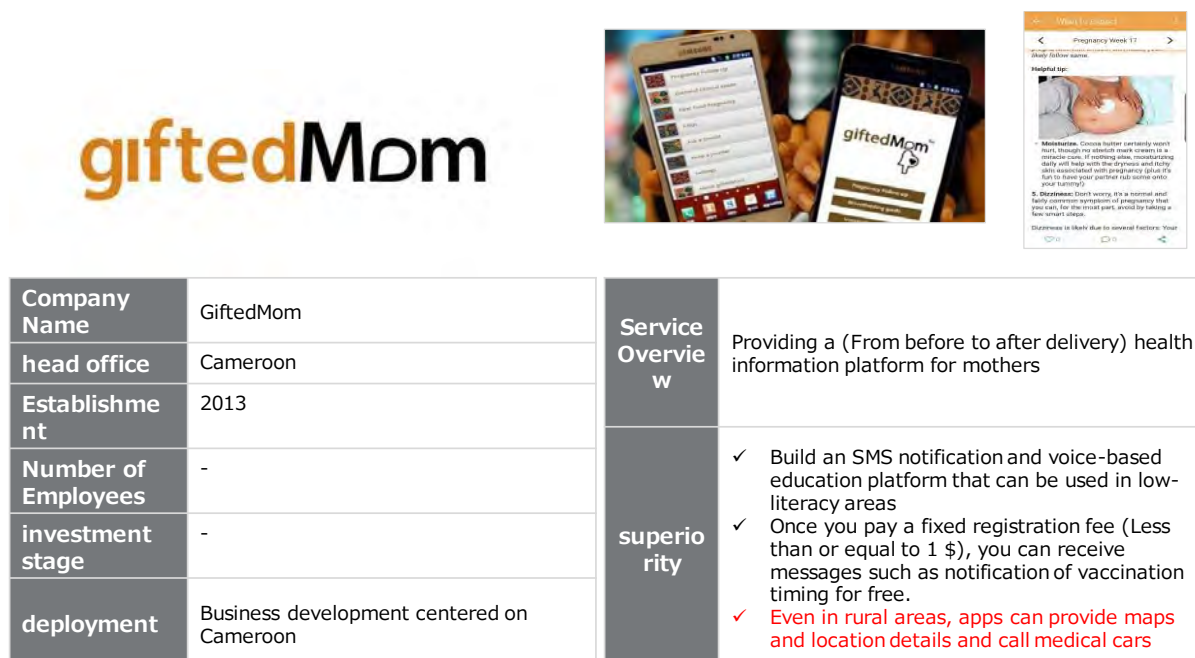
Figure 2-34   Health information platform

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (5)

NTT Docomo and Fujitsu has developed a system that allows expectant and nursing mothers to centrally manage and check the results of their own medical examinations. (digitalization of the maternal and child health handbook and linkage with medical records in hospitals)

Company Name	NTT DOCOMO X Fujitsu		Service Overview	Sales of "Prenatal checkup result reference service" linking DOCOMO's "Maternal and Child Health Handbook Application" with electronic medical records and Fujitsu's healthcare information infrastructure to medical institutions
Head office	Japan			
Establishment	Launched on April 1, 2019			
Number of Employees	-		Superiority	✓ You can manage your own medical information and echo images, and check comments and advice from doctors without going to the hospital.
Investment stage	-			✓ Business model: paid by medical institutions and used for free by pregnant women
Deployment	Implemented in Tokyo, Shizuoka, Ehime, etc.			

Figure 2-35   Digitalization service to link maternal and child health handbook to electronic medical records in hospitals

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (6)

Zipline International has developed drone delivery of blood and medicines with the aim of providing immediate access to essential medicines to all humans in the world.

Company Name	Zipline International Inc.		Service Overview	GPS-regulated drone delivery of blood products to medical institutions
Head office	State of California, U.S.A.			
Establishment	2014			
Number of Employees	101 -250 people		superiority	✓ It took 4 hours by car to deliver blood products to a hospital in a remote area but with their service it takes only 15 minutes.
Investment stage	Series C $233 M (Approx. ¥26 billion)			✓ Africa's latest Unicorn in early 2019
Deployment	Currently operating in Rwanda and Ghana with plans to expand throughout Africa, the United States, Southeast Asia and South Asia			✓ Riverse innovation to the United States

Figure 2-36   Drone delivers blood and medicines

Source: JICA Survey Team based on the website of the company concerned

ii)   Digitization of health insurance systems

In order to examine the applicability of digital technology in the medical insurance system, in the following figure we organize solutions corresponding to challenges of relevant stakeholders, taking as example the case of improving the efficiency of medical fee billing through receipts in Japan.
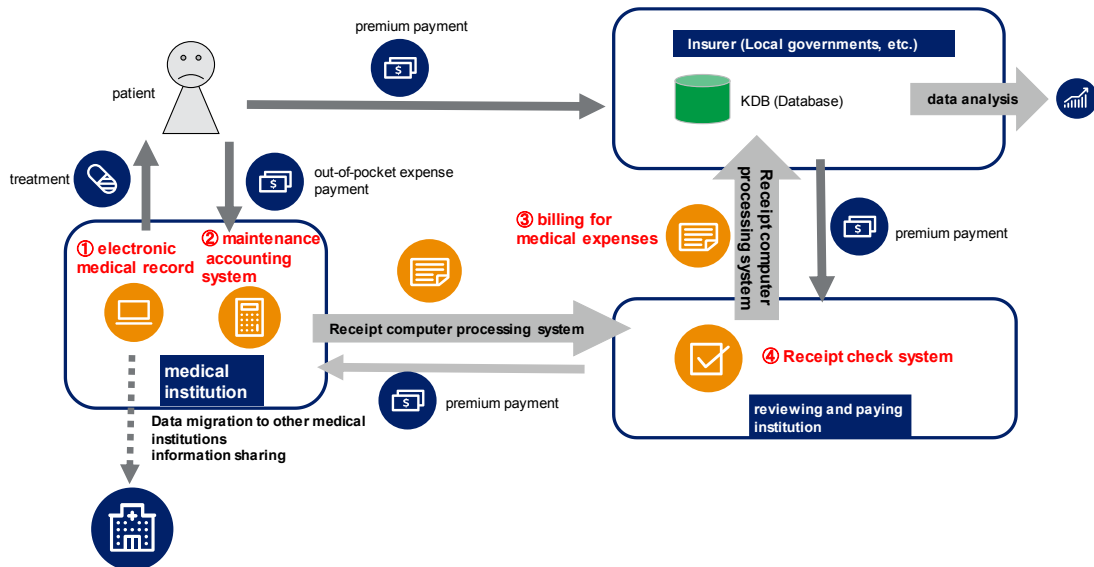
Figure 2-37   Increasing the efficiency of medical fee claims through receipt

Source: JICA Survey Team

We have summarized the information, including the name of companies, their services, and an outline of their advantage, of various solutions which may contribute to the digitization of medical insurance system as follows.

Example of ICT solutions (7)

Orbit Health is a start-up from Ethiopia which develops and provides online reservation systems to digitize medical information and improve operational efficiency.

Company Name	Orbit Health
Head office	Seattle, USA
Establishment	2018
Number of Employees	11 people
Investment stage	Startup
Deployment	Sub-Saharan Africa

Service Overview	✓ A consultation reservation system and an electronic medical record (EMR) management system ✓ Implemented at Ethiopian hospitals to improve operational efficiency
superiority	✓ Make workflows of hospital operations ✓ Platform for sharing EMR information among local medical institutions

Figure 2-38　Improving the efficiency of electronic medical record and other hospital operations

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (8)

Seven Seas Technologies is one of leading IT companies in Kenya, funded by Toyota Tsusho, providing digitalization of hospital systems (improving the efficiency of hospital operations including electronic medical records).

Company Name	Seven Seas Technologies Limited
Head office	Nairobi, Kenya
Establishment	May 1999
Number of Employees	108 people
Investment stage	–
Deployment	Kenya

Service Overview	✓ Promoting the supply of medical equipment, the digitalization of diagnostic image data, and the adoption of electronic medical records at all 98 Kenya National Hospitals
Superiority	✓ One of Kenya's leading IT companies providing ICT network solutions to improve the convenience of medical/public services and problem solving, and to promote better services. ✓ 4.5 million USD investment from Toyota Tsusho ✓ Significant service experience in Kenya

Figure 2-39 Improving the efficiency of electronic medical record and other hospital operations

Example of ICT solutions (9)

HealtheeOne provides services to improve the operational efficiency of clinics (from electronic medical records to receipt operations) in rural areas and developing countries where medical personnel is limited.

Company Name	HealtheOne Corporation		Service Overview	✓ Digitalization and cloud computing system for a series of clinic operations ✓ Digitalize medical records on paper ✓ Electronic payment of medical expenses and advanced payment/collection of medical treatment fee credit
Head office	Iwaki City, Fukushima Prefecture			
Establishment	2015		Superiority	✓ Well designed UI (User Interface)/UX(User Experience) ✓ Compatible with tablets and smartphones
Number of Employees	-			
Investment stage	preceed			
Deployment	Japan, Indonesia			

Figure 2-40   Digitalization and cloud computing system for a series of clinic operations

(4)   Potential OI Themes

In the area of health system efficiency, dissemination and strengthening of the continuum of care is a possible OI theme candidate after the comparison of candidate themes in terms of diversity of solutions and possle wayout of the pilot.

Table **2-14**   Candidates of open innovation themes

Challenges	ongoing relationship technical cooperation project	Theme Candidate	Diversity of solutions	potential outlet
Improvement of medical services	Maternal and Child Health Services Improvement Project (PRESSMN) Phase 3	Dissemination and reinforcement of continuous care	○	Develop as an additional component of an existing Technical Cooperation?
		Communicating with the community and medical staff	△	Develop as an additional component of an existing Technical Cooperation?
		Practice of evidence-based maternal and newborn care	△	Develop as an additional component of an existing Technical Cooperation?
Expansion of the healthcare system	Community Health Insurance and Free Health Care Capacity Building Project	Digitization of the health insurance system (Automation of Electronic Medical Records and Medical Fee Systems)	△	Develop as an additional component of an existing Technical Cooperation?
		Promoting enrollment and use of the health insurance system	△	Develop as an additional component of an existing Technical Cooperation?

2.3.2 Efficient maintenance and management of the power grid

(1) Current status and issues of electricity transmission and distribution networks (Off-grid is out of scope)

Amid rapidly expanding demand for electricity in line with economic growth and population growth, improving the efficiency of the maintenance of the power transmission and distribution network in Senegal has become a major issue for the stable supply of electricity as well as the development of alternative energy sources for thermal power generation and the establishment of international interconnected transmission lines. The challenges in power transmission and distribution are shown below.

Table 2-15 Power/Transmission and Distribution Issues

Domestic challenge	Transmission and distribution maintenance-management efficiency	■ The transmission and distribution loss rate reached 21% (*1) due to the aging of transmission and distribution facilities (Substations, etc.).There are frequent blackouts mainly in residential area of the poor. ■ Electricity generation and transmission and distribution is managed by the Senegal Electricity Corporation (Société nationale d'électrité du Sénégal), a national company, but there is a lack of budget for the repair of infrastructure related to transmission and distribution. *1: Senegal Power Company, 2016
	Development of alternative energy sources to thermal power generation	■ Electricity production in Senegal depends on thermal power plants using imported diesel or heavy oil, and its cost are considerable. ■ In order to break from dependence on thermal power generation, the Senegal government has amended laws and regulations to establish a legal framework to promote private investment and the development of alternative and renewable energy, and is moving ahead with plans to diversify the energy mix, but further efforts are necessary.
International Challenge	Development of international interconnection transmission lines	■ Regional cooperation and the construction of international interconnected transmission lines under the auspices of OMVS (Senegal River Basin Development Authority), ECOWAS (Economic Community of West African States), and UEMOA (Economic Community of West African States) are also underway, but further efforts are necessary.

Source: JICA "The Project for Emergency Rehabilitation and Reinforcement of the Dakar Distribution Network" Ex-ante Evaluation Sheet, and JETRO "Senegal electricity sector survey electricity production and supply" Report

The power sector in Senegal is operated by the state-run Electricity Authority of Senegal, which is responsible for generation, transmission, and distribution of electricity, and there are limited private players in the field. Below table shows concerned government agencies and private companies.

Table 2-16 Stakeholders related to power supply and distribution

Organization Name	Outline and Roles
Ministry of Energy and Mines, Agence Nationale des Energies Renouvelables (Renewable Energy Agency)	Prepare and implement sectoral strategies as determined by the president
Commission de Regulation du Secteur de l'Electricite (CRSE)	Electric Power Sector Regulatory Commission. an independent agency responsible for regulating the production and transportation and distribution and retail of electricity.
Societe Nationale d'Electricite (SENELEC)	Senegal's national power company. the Senegalese government owns 100% of the company
Agence Senegalaise D'Electrification Rural (ASER)	Senegal Rural Electrification Authority. Conduct local power transmission and distribution. Established in 2000 with funding from international donors
Agence Por L7 Economie et Maitrise de l'Energie (AEME)	Energy Conservation and Management Agency. Established in 2011 to promote energy conservation for environmental protection and sustainable development
Societe Africaine Raffinage	African Petroleum Refining Company. Senegal's industrial concern founded in 1961. ensure the supply of petroleum products to domestic and regional markets
GTI	Private independent power companies. Power is supplied only to SENELEC. Operates and manages a power plant with gas and steam turbines
CLUE Corporation	A Japanese company that uses drones for outdoor and exterior inspections. It provides monitoring and monitoring of construction sites and infrastructure facilities, operation methods, and after-sales support in a package.
Hibot Co., Ltd.	Japanese company inspects high-voltage overhead transmission lines using cutting-edge robot technology

Source: JICA Survey Team

(2) Recent cooperation by JICA and other donors

In the field of electric power, JICA has been providing grant aid for the renovation of substations and the improvement of power distribution networks in Dakar.

Table 2-17 JICA's Assistance in the Power Sector

#	Deal Name	Scheme	Duration	C/P	Summary
1	Project for Urgent Rehabilitation and Strengthening of Energy Distribution Network in Dakar Region	ODA Grants	2017-20	Power Authority of Senegal	The project aims to ensure a stable supply of electricity to the eastern part of Dakar, mainly in the newly developed area, by improving the regional power distribution network, thereby contributing to the revitalization of socio-economic activities in the area, with the renovation and reinforcement of the Sokosim switchyard located in eastern Dakar as a substation and transmission lines in its surrounding areas.

Source: JICA Survey Team

As shown in the following table, for project related to electricity, mutiple forms of support have been provided, including the introduction and promotion of renewable energy.

Table 2-18 ICT-Related support from other donors in the electric power sector

#	Donors, etc.	Deal Name	Duration	C/P	Summary
1	World Bank	Senegal Electricity Sector Support Project	2015 ~2022	Energy sector players	Assistance for the entire supply chain, including power generation fields such as solar power generation IPP and Tobene Power, rehabilitation of power transmission and distribution networks, OMVS international cooperation lines, rural electrification, and electric sector reform.
2	USAID	Power Africa	~2025	Energy sector players	Assistance for the development of Grid Code and Feed-in Tariff, assistance for project management related to rural electrification, and training for SENELEC related to renewable energy are provided through technical assistance through the project.
3	French Agency for Development (AFD)	Strengthen and modernize the electrical network of SENELEC	2018~	SENELEC	As demand for electricity increases, there is a need to improve the energy mix and the quality of services. The project is supported by the French Agency for Development and the EU in particular with the aim of improving the capacity of SENELEC (Senegal National Power Company).

Source: JICA Survey Team

(3) Applicability of various digital technologies

In Japan and other developed countries, digitalization is progressing with solutions from private sector to improve the efficiency of the value chain from power generation to retail.
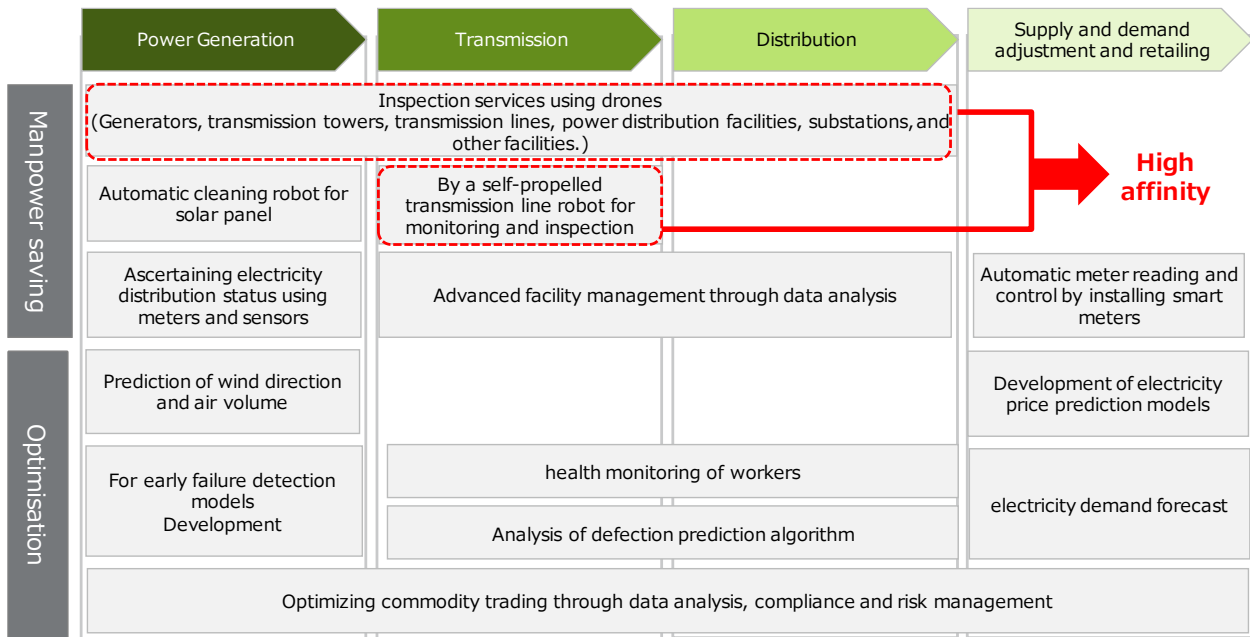
Figure 2-41　Examples of solutions leveraging STI

Source: Excerpt from the Agency for Natural Resources and Energy "Digitization in the power sector"

We have summarized the information, including the name of companies, their services, and an outline of their advantage, of digital technologies which may contribute to improving the efficiency of maintenance of the electricity and power grid in Senegal as follows.

Example of ICT solutions (1)

CLUE is developing and providing monitoring and surveillance of infrastructure facilities using drone technology, with the aim of solving issues with the power of technology.

Company Name	CLUE Corporation
Head office	Japan
Establishment	2014
Number of Employees	-
Deployment	A fixed-point observation system using drones was introduced in the Tema Intersection Improvement Project in Ghana (Shimizu Corporation).
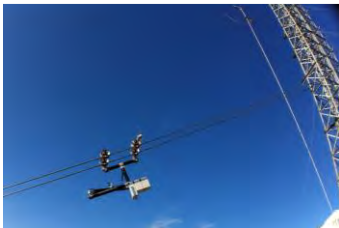
Service Overview	Outdoor and exterior inspection by drones • Monitoring of construction sites and infrastructure facilities • Get the services you need — including deployment, how-to, and after-sales support — in a package
Superiority	✓ Operation can be performed by simple operation using a dedicated application. ✓ No dedicated device required and it reduces initial cost ✓ Project experience in Africa

Figure 2-42　A fixed-point observation system using drones

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (2)

HiBot offers solutions to infrastructure issues through university-launched ventures, and is developing automated inspection system with self-propelled robot on power transmission lines.

Company Name	Hibot Co., Ltd.		Service Overview	Inspection of ultra-high voltage overhead transmission lines using state-of-the-art robot technology
Head office	Shinagawa-ku, Tokyo			
Establishment	2004			
Number of Employees	16		Superiority	✓ Development capabilities for special environments such as on-site inspections at the Fukushima nuclear power plant
Deployment	Japan			✓ Introduction of products around the world

Figure 2-43 Inspection of Ultra-high Voltage Overhead Transmission Lines Using State-of-art Robot Technology

Source: JICA Survey Team based on the website of the company concerned

(4) Potential OI themes

Below table shows possible candidates for the OI theme about power supply and distribution. As a result of discussions with the JICA office on the identified issues, the most promising candidate was considered to be the improvement of efficiency in the maintenance and management of power transmission and distribution networks by saving manpower, which is highly relevant to existing grant aid projects. However, since there are no technical cooperation projects on-going in the electric power sector, it is expected that it will be more difficult to deepen understanding of issues through stakeholders who are familiar with local issues.

Table 2-19 Possible Candidates for the OI-theme on Improving the Efficiency of Maintenance and Management of Power and Transmission Networks

Challenges	Existence of relevant technical cooperation projects currently being implemented	Theme	Diversity of solutions	potential outlet	Remarks
Efficient maintenance and management of transmission and distribution networks	None	Efficient management of power transmission and distribution networks through labor-saving	△	Private Sector Partnership Projects	1 grant aid project "Project for Urgent Rehabilitation and Strengthening of Energy Distribution Network in Dakar Region" was implemented.

Source: JICA Survey Team

2.4   Benin

2.4.1   E-Government

(1)   Current status and issues in E-Government

The Government of Benin has positioned the introduction of smart government and the dissemination of digital technology through education in 40 flagship projects included in the Government Action Programme (PAG) 2016-2021. PAG stipulates smart government and the diffusion of digital technology through education, and the outline of the PAG (issues, outline of measures, timeline, etc.) is shown in the following figure.
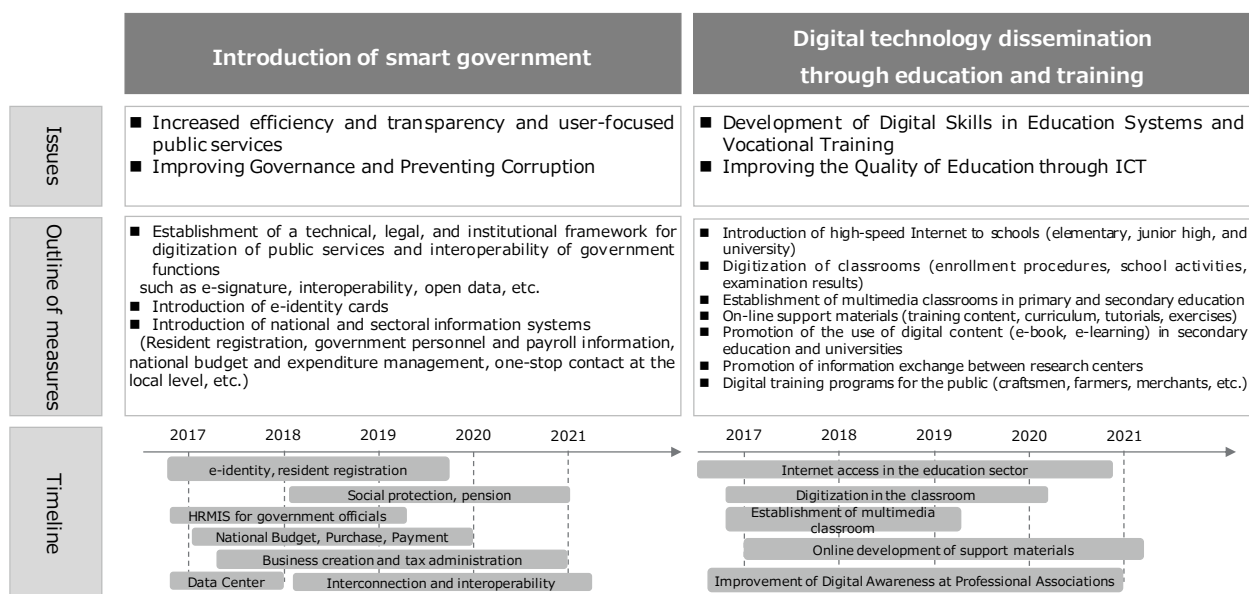
Figure 2-44   Positioning of Smart Governance and Digital Technology Dissemination through Education

Source: Government Action Programme for 2016-2021

The list of the stakeholders for E-government is shown in below table. The key is whether the Ministry of Digital and Digitization can strongly promote the digitization of government functions and the digital economy through ensuring collaboration across Ministries.

Table 2-20 E-government stakeholders

Organization Name	Overview and role
Ministère du Numérique et de la Digitalisation (Ministry of Digital and Digitalization)	Responsible for digitization of government functions and digitization of the overall socio-economic system in Benin
Ministère de la Décentralisation et de la Gouvernance Locale(Minister for Decentralisation and Local Governance)	Responsible for decentralization of government functions and improvement of local governance. It is responsible for the development of digital infrastructure in rural areas and the strengthening of the authority of regional institutions through the digitization of government functions.
Ministère de la Communication et de la Poste (Ministry of Communication and Post Office)	Responsible for telecommunications technology and infrastructure development and postal services
Digital Council	Cross-agency council responsible for digital policy review, strategy formulation, and implementation management.
Digital Economy Agency	As the implementing agency of the Digital Council, it is in charge of project planning, implementation, and securing resources across ministries and government agencies.
NEC	Japan's leading telecommunications company. Through investment in CSC e-Governance Services India Ltd (CSC), it provides digital services to approximately 900 million people living in rural India. CSC provides more than 300 types of public services, including the issuance of administrative documents, subsidies, and private services, such as mobile phone contracts and the sale of insurance products.
Ericsson	Swedish telecommunications equipment manufacturer. It develops wireless BB networks (LTE/HSPA), convergence between wired and mobile communications (FMC), and convergence between broadcasting and communications (IPTV) for practical use. Introduction of e-Government Cloud in Estonia and pilot projects for 5G.
MTN Online	A Nigerian company that develops high-speed Internet infrastructure. It is one of the major mobile telecommunications companies in Africa. In addition to its mobile business, it is also engaged in the construction of 4G wireless networks.
Education Information Service Co., Ltd.	Using Think Board (video content production software) to develop the contents of mandatory courses designated by the Kenyan government. The produced video content is very light, with a capacity of 3 MB even 10 minutes, and can be introduced in a vulnerable network environment.
Future Corporation	Implementation of a feasibility study (SDGs Business Support Type) for the development and offshoring of AI human resources through on-line education related to vocational training in JICA survey projects

Source: JICA Survey Team

(2) International trend

Estonia, an advanced country in the field of e-government, has been introducing various services based on a common infrastructure and IT infrastructure. The structure of e-government of Estonia is shown in below figure.
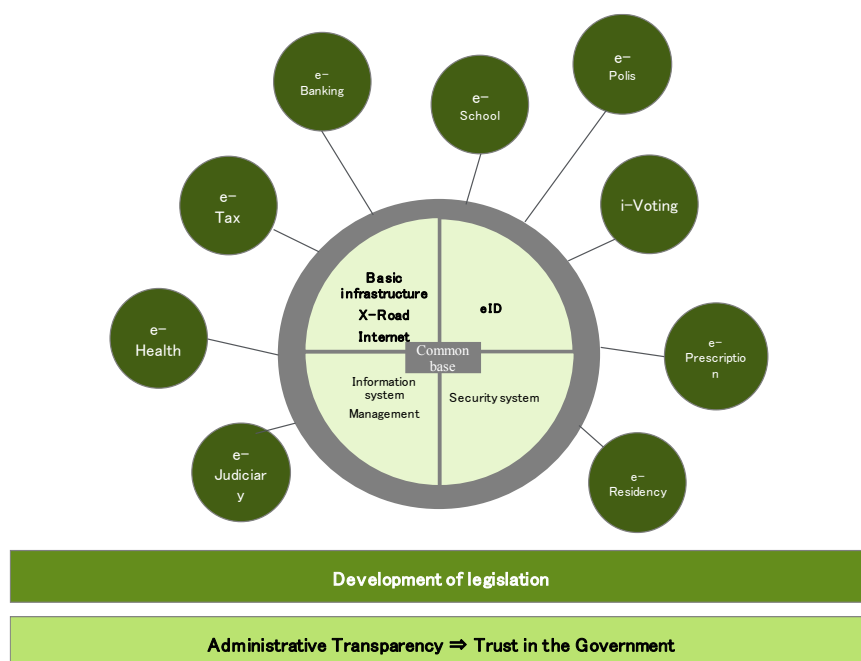
Figure 2-45 Estonia's e-government structure

Source: JICA Survey Team

Estonia has promoted ICT education for its people in parallel with the development of the infrastructure and introduction of services for e-government. The following figure shows the components of e-services and ICT education with their progress.
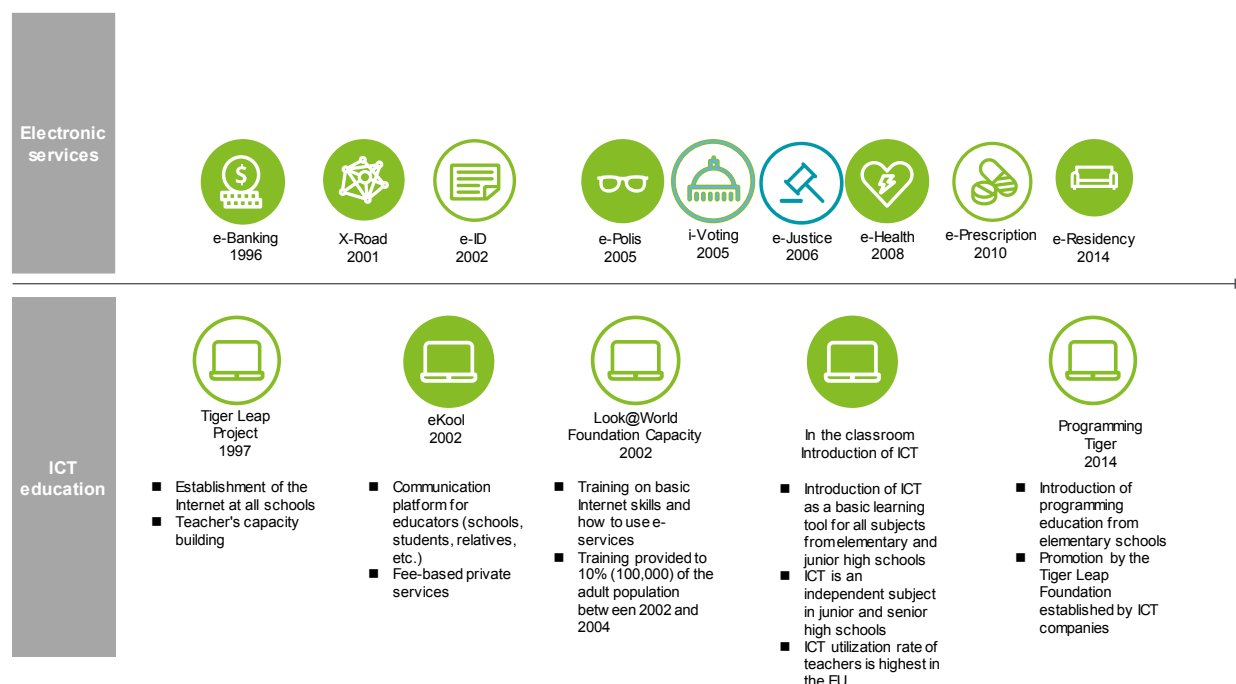
Figure 2-46   Evolution of the introduction of e-government in Estonia

Source: Challenges of Future-oriented Estonia, etc.

As shown in the following table, since 2017, Estonia has been supporting the Government of Benin in introducing E-government.

Table 2-21   Estonia's support

Implementing Agency	Implementation timing	Contents of support
Cybernetica *Estonian private company that developed Estonia's information sharing layer, X-Road, and an electronic voting system **e-Governance Academy** * Non-profit think tank and consultant organization established by Estonian government, the Open Social Research Institute, and UNDP in 2002	From 2017	✓ As of March 2019, pilot activities related to the introduction of key elements of the platform are underway. ✓ It will soon moved forward to implementation phases, including the introduction of interfaces and services used by the public and various organizations. ✓ After the implementation phase begins, support and consultants for government leaders and bureaucrats to develop an ecosystem will be provided. ✓ E-Governance Academy is working to establish a Benin government organization in charge and a regulatory framework. ✓ In addition, training is being provided for bureaucrats and IT experts on interperable solutions, guidelines and procedures, and key standards for the introduction of e-government.

Source: E-estonia HP (https://e-estonia.com/cybernet ca-data-exchange-to-benin/)

(3) Applicability of various digital technologies

The process of introducing e-government is as follows. First, it is necessary to strengthen the basic functions of the government, and then develop the IT environment and common infrastructure.
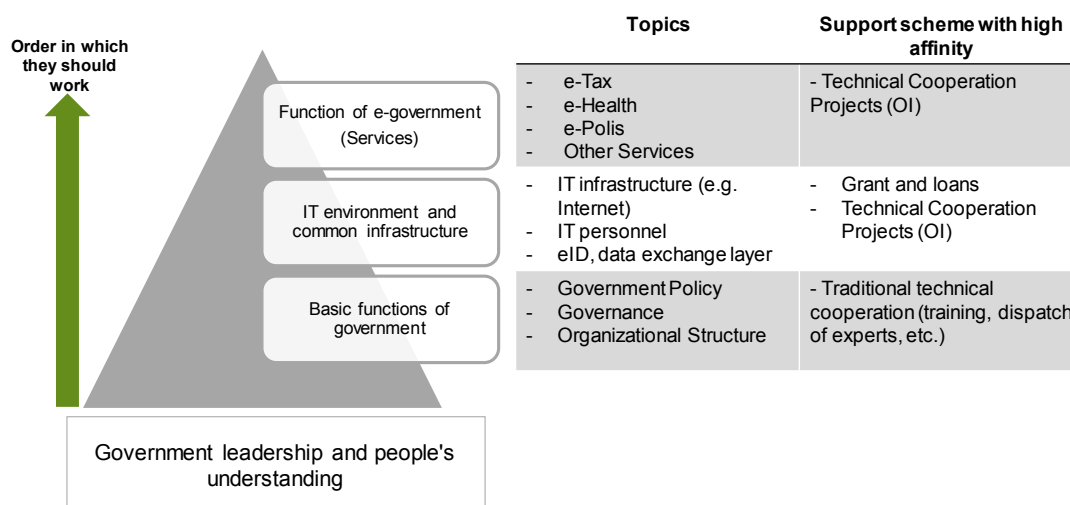
Figure 2-47   E-government introduction process

Source: Research Report of JICA "Research on ways to cooperate with e-government related projects" (2007)

The following figure illustrates the type of solutions which may contribute to building the function of E-government.
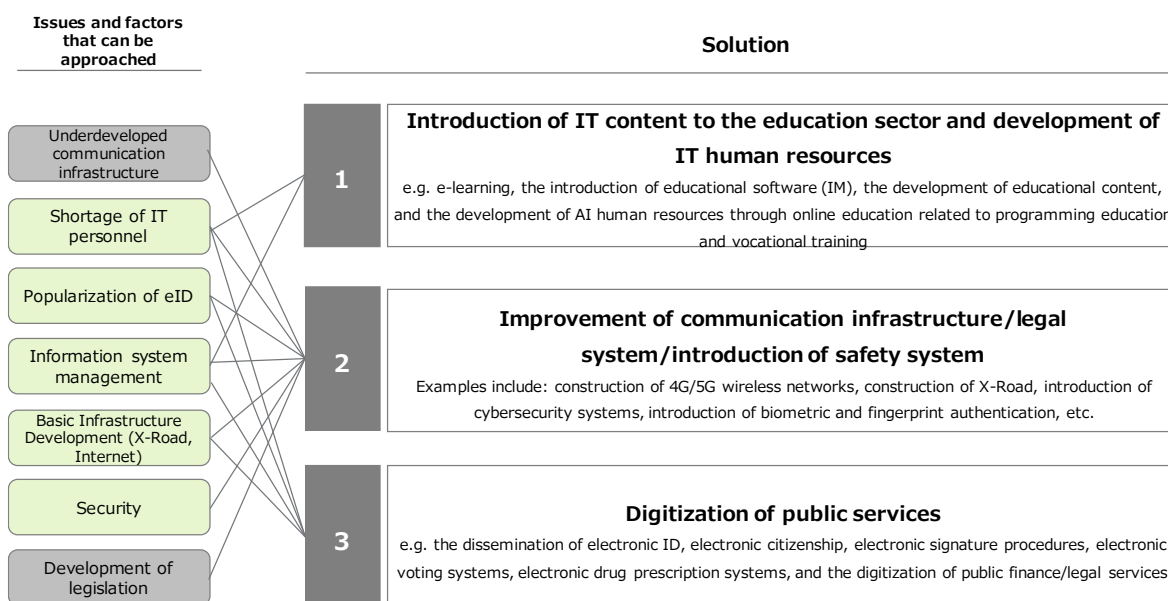
Figure 2-48   Existing ICT solutions for issues

We have summarized the information, including the name of companies, their services, and an outline of their advantage, of digital technologies which may contribute to building the function of E-government as follows.

Example of ICT Solutions (1)

Academic Bridge is a Rwandan venture company that provides a platform for IT management in education, and is introducing ICT into the education sector.
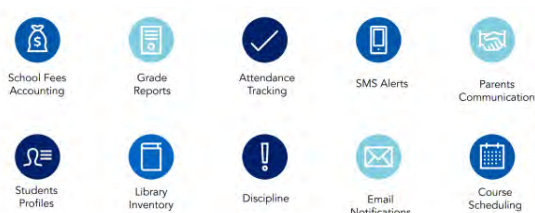
Company name	Academic Bridge
Head Office	Rwanda, Kigali
Establishment	2014
Number of Employees	14 people
Investment stage	-
Deployment	Rwanda

Service overview	✓ **Management software that enables schools to manage, analyze, process and share student data** ✓ **Communication tool between educators (schools, students, parents)**
Superiority	✓ Sophisticated customization to meet customer needs ✓ UI/UX ✓ Price

Figure 2-49   Introduction of ICT in education

Source: JICA Survey Team based on the website of the company concerned

Examples of ICT Solutions (2)

Life is Tech is a Japan-based venture company that provides programming education for junior and senior high school students, introduces IT content to the education sector, and educates human resources.

Company name	LIFE IS TECH Inc.
Head Office	Tokyo
Establishment	2010
Number of Employees	55 people
Investment stage	Total ¥2.5 billion (public information)
Deployment	Japan, the United States

Service overview	✓ **Planning and operation of IT and programming education camps, schools and events for junior high and high school students** ✓ **Subjects are smartphone apps, games, web, video, music, design, 3DCG, IoT, etc.** ✓ **Development and operation of online programming education services**
Superiority	✓ Programme design not only for programming learning but also for drawing out the creative power of participants ✓ MOZER, a three-second step-by-step™ interactive online learning system

Figure 2-50   Introduction of IT content and human resources education in the field of education

Source: JICA Survey Team based on the website of the company concerned

Example of ICT Solutions (3)

Ceed Learning is a venture company from South Africa that is implementing e-learning and providing online courses and other content.

Company name	Ceed Learning (Pty) Ltd
Head Office	South Africa, Johannesburg
Establishment	2019
Number of Employees	14 people
Investment stage	-
Deployment	South Africa

Service overview	The company provides e-learning and educational content such as online courses. It will also build a platform for learning systems and capacity building. It also develops mobile applications.
Superiority	✓ Providing integrated services such as planning of learning strategies, management improvement through digital learning and digitization, construction of platforms and capacity building ✓ Developing learning applications for smartphones. ✓ Participation in many international conferences on e-learning and innovation in learning technologies

Figure 2-51   Introduction of IT content and human resources education in the field of education

Source: JICA Survey Team based on the website of the company concerned

Examples of ICT Solutions (4)

NEC has developed the world's No. 1 accurate face recognition, a system that can authenticate people even when they are wearing masks, sunglasses, or lying down.

Company name	NEC
Head Office	Tokyo, Japan
Establishment	In 1899
Number of Employees	Non-consolidated 20,252 (as of March 31, 2019)
Investment stage	-
Deployment	With over 1,000 systems installed in about 70 countries and regions

Service overview	NEC boasts over 1,000 installations in approximately 70 countries and regions of biometric identification. In particular, face authentication is used not only for immigration control and national security such as national ID, but also for various other purposes such as entry and exit control, terminal login and payment.
Superiority	✓ **Face authentication boasts the world's No.1* accuracy. No.1 in five benchmarks sponsored by the National Institute of Standards and Technology** ✓ **Masks, sunglasses, and horizontal authentication are also possible.** ✓ Characteristics of facial authentication that combines robust security with convenience can be utilized in a variety of situations (examples: admission management, face authentication settlement, etc.)

Figure 2-52   Improvement of communication infrastructure and introduction of safety systems

Source: JICA Survey Team based on the website of the company concerned

Example of ICT Solutions (5)

De Ra Lue creates and implements multi-functional smart ID cards in Rwanda, using advanced security printing and papermaking technologies as its backbone.

Company name	De Ra Lue
Head Office	Hampshire Baising Stoke, United Kingdom
Establishment	In 1821
Number of Employees	N/A
Investment stage	--
Deployment	Expanded to 142 countries including Africa

Service overview

A British company that handles security printing, paper and bill identification systems. In addition to bills, the company manufactures secure documents such as passports, vouchers, revenue stamps, traveler's checks, driver's licenses, bank checks, and postage stamps. The company also manufactures cash-processing machines, such as banknote counters, bill sorters, money sorters, ATMs, and bill issuing machines, using the technology of the bill identification system.

Centered on the aforementioned core business, the project is currently working with the Rwandan government to create and implement a multi-function smart ID card and provide a safe system for accessing government services. In Rwanda, the company has already manufactured a national ID card, and the smart ID card introduced this time includes health information as well as passports and driver's licenses. Expansion into the East African Community (EAC), such as Kenya, centering on Rwanda

Superiority

✓ With its advanced printing and paper manufacturing technologies, the Company is contracted to manufacture more than 150 types of banknotes.
✓ **It also covers the IT field, such as manufacturing and introduction of key technologies for security printing and paper manufacturing and bill identification systems.**
✓ The companies listed on the London Stock Exchange and FTSE 250 are well-financed.

Figure 2-53   Digitization of public services

Source: JICA Survey Team based on the website of the company concerned

(4)   Potential OI themes

A candidate for the OI theme could be IT in education. In any case, it is important that the ministry in charge of digitalization and digitization is able to strongly promote the digitization of government functions and the promotion of the digital economy, and that it is able to promote policies across ministries.

Table 2-22   Possible choices for OI themes

Issue	Related Technical Cooperation Projects Currently Implemented	Theme choices	Diversity of solutions	Possible exits
Development of IT Human Resources for the Development of Infrastructure for Introducing E-Government	None	Adoption of IT in the classroom (educational contents, management and communication, distance learning, etc.)	○	Development as new technical assistance or private partnerships?
		Implementation of IT education (e.g. programming education)	△	Development as new technical assistance or private partnerships?
		Introduction of high-speed Internet to educational institutions	△	Grant Aid?

Source: JICA Survey Team

2.4.2 Improving efficiency and lowering costs of aquaculture-related technologies

(1) Current status and issues in inland water aquaculture

Fishery products are the main protein source in Benin, and inland water aquaculture is an important industry for food security. However, Benin has faced various issues such as seeding, raising and feeding fish, and management of related technologies and environment. The challenges in inland water aquaculture include followings.

Issues in the Fisheries Sector

- Although fishery products account for 53% of the domestic protein source, Benin depends on imports for approximately 76% of its domestic consumption and is in a very vulnerable state in terms of food security (as of 2014).
- As the population grows, demand for fishery products is expected to increase further, making the expansion of total aquaculture production an urgent issue

Potential for inland aquaculture

- As the coastline is short at about 125 kilometers, there is limited room for increased production in sea-level fisheries. However, the inland area has a brackish water area of about 33,300 hectares, a river water area of about 700 kilometers and floodplains of about 200,000 hectares, and has high potential for inland water aquaculture.

Issues in promoting inland water aquaculture

- Low technical proficiency in aquaculture pond management
- The quality of seeds and seedlings is poor, and access to quality seeds and seedlings is difficult.
- Improper guidance by extension workers on the location and construction conditions of aquaculture facilities
- Insufficient provision of technical services related to aquaculture development and dissemination
- Required initial investment is high
- Insufficient financial assistance available for starting / maintaining aquaculture
- Have difficulty in feeding fish
- There is an influx of imported (cheap) fish
- Insufficient awareness of problems related to inland waters (degradation of inland waters, reduction of fishery resources, use of environmentally destructive fishing gear, disorganized use of waters, dumping of waste, etc.)

In the inland water aquaculture sector, there are some Japanese companies in the area of managing water quality and fish growth.

Table 2-23 Stakeholders related to inland water aquaculture

Organization Name	Overview and role
Ministry of Agriculture, Livestock and Fisheries (MAEP)	Ministry in charge of agriculture, livestock and fisheries, and the Fisheries Bureau (Fisheries Technical Division)
Department of Fisheries (Direction des P ê Chests: DP)	Responsible for marine fisheries, inland fishery aquaculture, marine product quality fishery management, etc.
Regional Agricultural Promotion Centre (CeRPA)	Responsible for dissemination activities for primary industries as a whole and deployed in six locations nationwide. The Agricultural Industry Promotion Department of the center will provide support for the entire industry, including aquaculture.
City Agricultural Promotion Center (CeCPA)	Located in the cities (77 cities nationwide) under CeRPA. Specialist livestock and aquaculture technicians are responsible for promoting the aquaculture sector, which is monitored by livestock and fisheries inspectors.
NTT DoCoMo	Joint development of ICT buoys that automatically measure sea water temperature and salinity, which are closely related to aquaculture yield and quality.
Endress+Hauser Process Solutions AG	Software tools developed to remotely control the water quality of aquaculture ponds by using sensing technology for water quality conditions, digitization of water quality information, and smartphones.
KDDI	Developed the "Umi-Medas" technology for automatically transmitting data on water temperature, oxygen concentration, and salinity concentration of aquaculture chairs to servers via mobile lines once an hour, and the "Digital Operation Log" technology for managing feeding locations, feeding volume, and timing using tablet inputs, and for providing data on the know-how gained from fishermen's experience and intuition.
Texter Inc.	Real-time monitoring of various water quality environments, including ponds, reservoirs, lakes, and aquaculture ponds. Data on water temperature, pH, dissolved oxygen, ammonia nitrogen, nitrite, etc. are provided in multi-device environments such as mobile phones, tablets, personal computers, etc.
Umitron Corporation	Development and provision of data platforms for aquaculture businesses.
Rio Fish	Kenyan start-up company developping smart application "Aquatech" for growth management
Nikken Leasing Industry Co., Ltd.	As part of the leasing and sales of transportation equipment and materials, Nikken Seikatsu-Box was developed to keep fish alive by letting them sleep on carbon dioxide to reduce the burden of transportation.

Source: JICA Survey Team

(2) Recent cooperation by JICA and other donors

JICA has supported the development of a master plan for the promotion of inland water aquaculture. In this field, JICA has a strong relationship with the central and local administrative agencies (MAEP, DPH, CeRPA, CeCPA, etc.), middle industry extension workers and core aquaculture workers.

Table 2-24 JICA's Assistance for Inland Water Aquaculture in Benin

#	Project Name	Scheme	Period	C/P	Overview
1	Inland Water Aquaculture Extension Project Phase 2 (PROVAC2)	Technical Assistance	2016-2021	MAEP/ DPH	The project aims to expand inland water aquaculture production by diversifying production technologies related to inland water aquaculture and strengthening the extension approach to farmers, thereby contributing to food security and poverty reduction in the country.
2	Water Aquaculture Extension Project in Benin	Technical Assistance	2010-2014	MAEP/DP	With the aim of increasing the number of aquaculture houses in seven provinces in southern Benin by, 1) establishing an inland water aquaculture technology, 2) fostering fishery extension workers and core aquaculture farmers, 3) fostering aquaculture farmers through private farmers' training, and 4) promoting the independent business management of aquaculture farmers.
3	Study of village development plan through domestic water aquaculture promotion in the Republic of Benin	Research	2007-2008	MAEP	The purpose of this study is to prepare a master plan (M/P) for the promotion of inland water aquaculture in Benin and an action plan (A/P) for its implementation.

Source: JICA Survey Team

At present, other donor's support for inland water aquaculture promotion in Benin has been limited

Table 2-25 Support by other donors in the field of aquaculture promotion

#	Donors, etc.	Project Name	Period	C/P	Overview
1	Wageningen University & Research (Netherlands)	Development and Demonstration of Mixed Feed to Strengthen Aquaculture Sector in Benin	January to December 2018 (1 year)		Through the development and dissemination of optimal ratios and ration-calculation computers, feeding experiments at farms, and data accumulation, this research was conducted to reduce the cost of aquaculture by promoting the development of mixed feeds using local feeds.

Source: JICA Survey Team

(3) Applicability of various digital technologies

While the process of aquaculture consists of three steps (water quality management, growth management, and shipment), how to optimize each process is critical.The following figure illustrates the type of solutions which may contribute to improving the efficiency of each process of aquaculture.
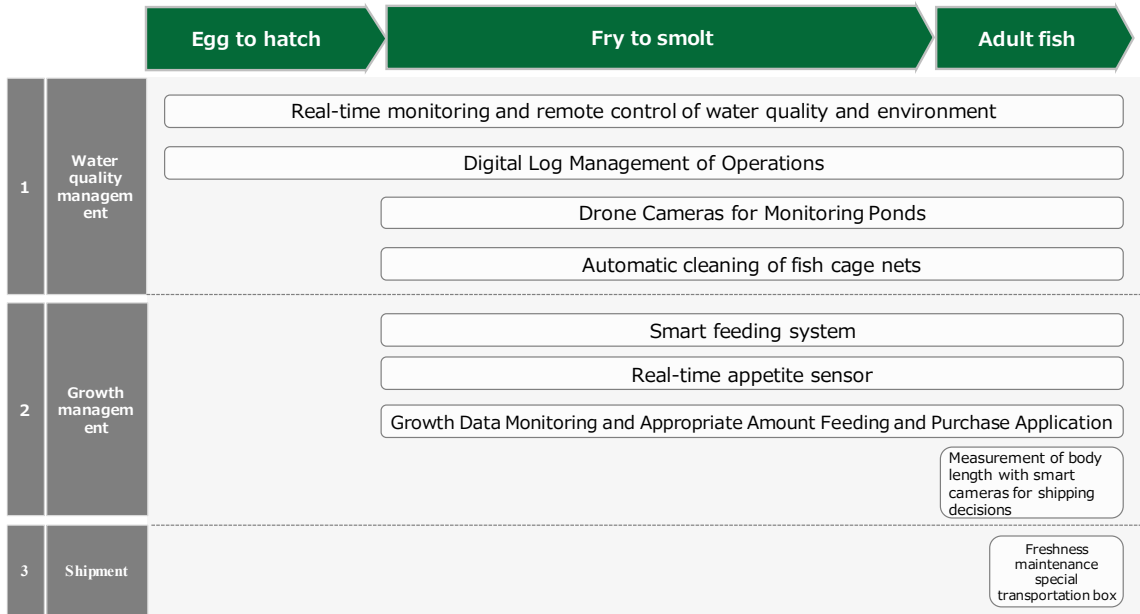
Figure 2-54   Existing ICT solutions

Source: JICA Survey Team

JICA Survey Team have summarized the information, including the name of companies, their services, and an outline of their advantage, of digital technologies which may contribute to improving the efficiency of aquaculture-related technologies as follows.

Example of ICT solutions (1)

NTT DoCoMo and Andex are developing mobile devices to reduce management costs by using ICT buoys to automatically measure water temperature and other parameters that affect the yield and quality of aquaculture.

Company name	NTT DoCoMo and Andex Co.,
Head Office	Tokyo, Japan
Establishment	--
Number of Employees	--
Investment stage	--
Deployment	Currently only in Japan. In Japan, the company plans to expand in areas such as Miyagi Prefecture.

Service overview	✓ ICT buoys are jointly developed to measure sea water temperature and salinity, which are closely related to aquaculture yields and quality, at all times. App provided under the name "Umi-Mill" sends measurement information to the cloud and help fishermen make appropriate decisions according to their circumstances. It also has a diary function to note the work and a bulletin board function to share opinions among members of fisheries cooperatives. Management costs are reduced by automating the collection of measurement information.
Superiority	✓ Automated monitoring of the growing environment and management of data accumulation, which used to relied on the experience and intuition of experienced farmers, resulted in labor saving and rationalization. It makes possible to share and accumulate knowledge by digitizing and sharing operation logs.

Figure 2-55   Aim to reduce management costs by mobile devices

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (2)

Umitron develops mobile devices and data solutions with the aim of "implementing sustainable aquaculture on the earth" through aquaculture x technology.

Company name	Umitron Corporation
Head Office	Tokyo, Japan
Establishment	2016
Number of Employees	21 people
Investment stage	Procurement of more than 2 billion yen through crowdfunding, capital increase, etc.
Deployment	In addition to Japan (Ehime Prefecture), a Salmon Trout production efficiency project is in progress in Peru.

Service overview	✓ IoT, satellite remote sensing technology and machine learning are combined to develop and provide the UMITRON CELL smart feeder, the UMITRON EYE smart camera-based movable property assessment service for aquaculture, and the UMITRON FAI real-time fish group appetite assessment system based on machine learning.
Superiority	✓ Systematization of work processes through the accumulation of growth data by smart feeders, improvement of production efficiency, reduction of environmental loads through reduction of waste feed, and improvement of working environment through efficiency improvement of on-site work.

Figure 2-56   Improving the efficiency of aquaculture by mobile devices and data solutions

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (3)

Rio Fish has developed mobile devices and e-commerce sites to promote smart aquaculture in Lake Victoria, with the aim of promoting rural food security, market system connectivity and women's rights protection.

Company name	Rio Fish
Head Office	Kenya
Establishment	2017
Number of Employees	− --
Investment stage	− --
Deployment	Kenya (Lake Victoria)

Service overview	✓ Through the compilation of data on growth management (water temperature and water quality monitoring) and cloud linkage, it makes possible to control the mortality rate and the rate of return on farmed fish, calculate the amount of appropriate food from the data, and develop a smart application called Aquatech, which is proposed to aquaculture. ✓ Developing a web application for market transactions in aquaculture fish to digitize market transactions in aquaculture fish.
Superiority	✓ Improvement of aquaculture efficiency in Lake Victoria and promotion of active participation and protection of rights of women who support their livelihoods in aquaculture by management of aquaculture fish through web apps, purchase of food through EC site linkage, and digitization of market transactions of fresh fish.

Figure 2-57   Smart aquaculture by mobile devices and EC site

Source: JICA Survey Team based on the website of the company concerned

(4)   Possible OI themes

Possible choices for OI themes include the following.

Table 2-26   Possible choices for OI themes

Issue	Current linkages Technical Cooperation Projects	Theme Candidate	Diversity of solutions	Possible exits
Efficiency and cost reduction of inland aquaculture	Inland Water Aquaculture Extension Project Phase 2 (PROVAC2)	Water quality management	△	Deployment as an additional component of existing technical assistance
		Growth management (feeding, etc.)	△	Deployment as an additional component of existing technical assistance
		Shipment	×	Deployment as an additional component of existing technical asssitance

Source: JICA Survey Team

2.5 Tanzania

2.5.1 Increasing efficiency and reducing cost for irrigation and agriculture

(1) Current status and issues in irrigation and agriculture

Challenges in agricultural sector

> Tanzania's agriculture is an important industry, accounting for about a quarter of the country's GDP and about 20% of its exports. In addition, about 70% of the total population (59.73 million in 2020) lives in rural areas and more than 80% of the labor force is engaged in agriculture. According to the Tanzanian National Bureau of Statistics, the poverty rate in rural areas (mainland Tanzania) averages 31.8%, which is much higher than the urban average of 15.8% (2018).

> For this reason, agriculture is seen as the core of economic growth and the key to poverty reduction in Tanzania, and the Tanzanian government has been promoting agricultural development. However, the growth rate of the agricultural sector has been 4-5%/year for the past several years, falling short of the government's target of 6%/year.

> Due to the delay in irrigation development, subsistence agriculture, which relies on rain-fed water, has become the mainstream, and this has contributed to the low growth rate of the agricultural sector (the average annual growth rate forecast for 2016-2026 is 4.2% according to Mordor Intelligence).

> Tanzania's revised National Irrigation Master Plan (2018) states that there are high irrigation development potential areas. The Tanzanian government has identified irrigation development as a priority and is promoting it through the Agricultural Sector Development Program (Phase 2) (2016).

Grain production share

> Maize and rice dominate the grain production in Tanzania.

> Exported agricultural products include coffee, cotton, tobacco, cashew nuts, and tea leaves.

> Rice consumption has been increasing year by year, and domestic production has been unable to keep pace with the increase in consumption, and the country is relying on imports. Increasing rice production is a food security issue.

> Rice production has high potential from a technological standpoint. Therefore, increasing rice production is important for the commercialization of agriculture.
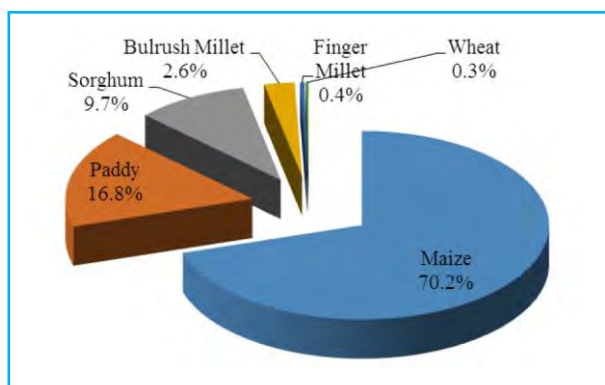
Figure 2-58 Grain production share

Source: JICA Survey Team

Government initiatives

Main policies related to agriculture include the following.

Table 2-27 Government initiatives

#	Policy document	Details
1	Agriculture Sector Development Program II (ASDP II)	Agricultural development framework that began in 2017/2018 as a phase 2 of the country system for domestic agricultural development
2	Kilimo Kwanza (Agriculture First)	Action plan announced by the president in 2009 to promote agricultural development
3	Tanzania Agriculture and Food Security Investment Plan (TAFSIP)	Published in 2011 following the Comprehensive Africa Agriculture Development Program (CAADP). Stipulate areas where private investment is necessary
4	Big Results Now	For sustainable economic growth, the document sets a policy to focus on three areas in the agriculture sector: the dissemination of small-scale irrigation; the construction of a maize marketing system; and the promotion of farming

Source: JICA Survey Team

Challenges in Tanzania's agricultural value chain

Challenges exist in each process of the value chain in Tanzania's agriculture, and innovative solutions are required to tackle them.
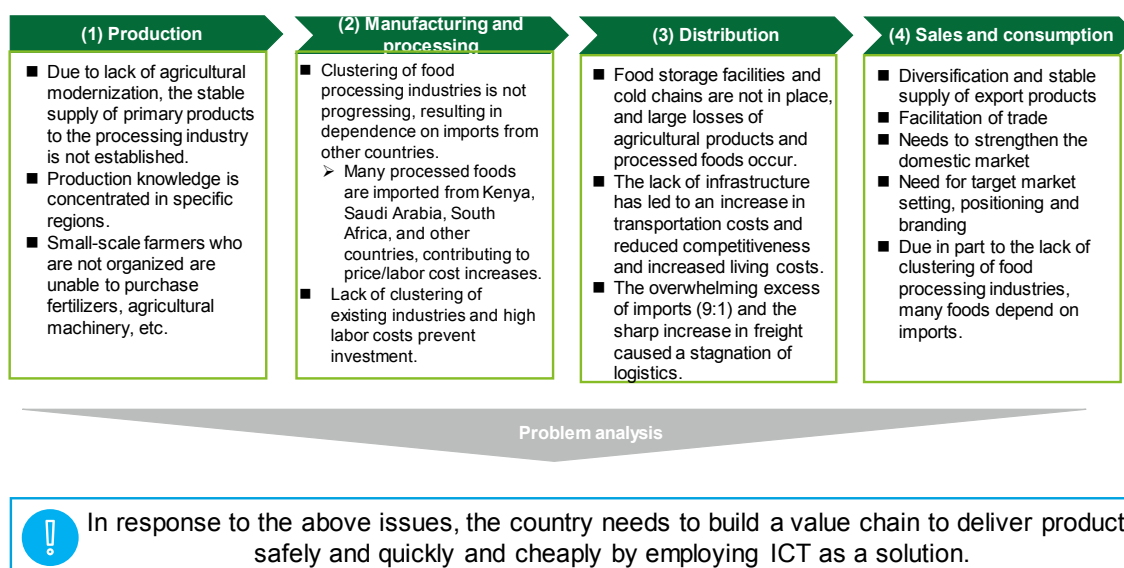
Figure 2-59 Challenges in Tanzania's agricultural value chain

Source: JICA Survey Team

Current status of irrigated agriculture

Tanzanian government has set out to implement irrigation facilities to 1 million hectares of arable land by 2020, but has achieved only 46,100 hectares, or 5% of total arable land. The challenges include the following.

➢ Tanzania's Ministry for Water has been introducing irrigation techniques since 2006, with a target of 1 million hectares of arable land by 2020.

➢ Achievements in 2017 were only 461,000 hectares, and irrigation was introduced to 5% of the total arable land.

➢ Priority areas for the agricultural sector to date have been seed improvement and promotion of fertilizer use, and interest in irrigation has been low.
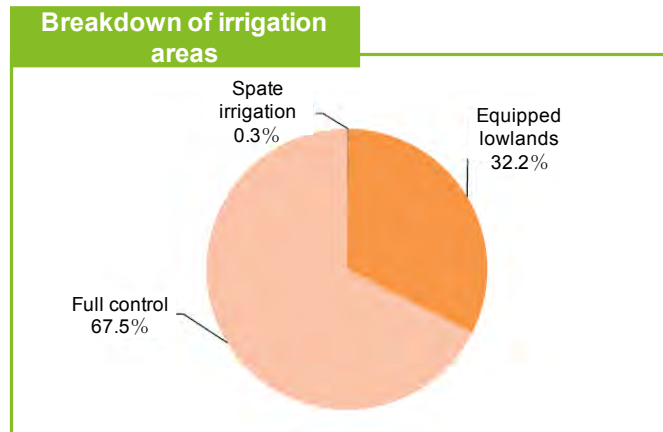
Figure 2-60　Breakdown of irrigation areas

Main crops produced by irrigated agriculture

➢ Major crops in Tanzania for irrigated agriculture are maize (31% of total irrigated land) and rice (21% of total irrigated land)

➢ The remaining 41% of arable land includes vegetables (onions, tomatoes, leafy vegetables), beans, sugar cane, cotton, and oil crops.

➢ In addition, coffee, tea leaves, and tobacco are produced using a small amount of irrigation equipment.
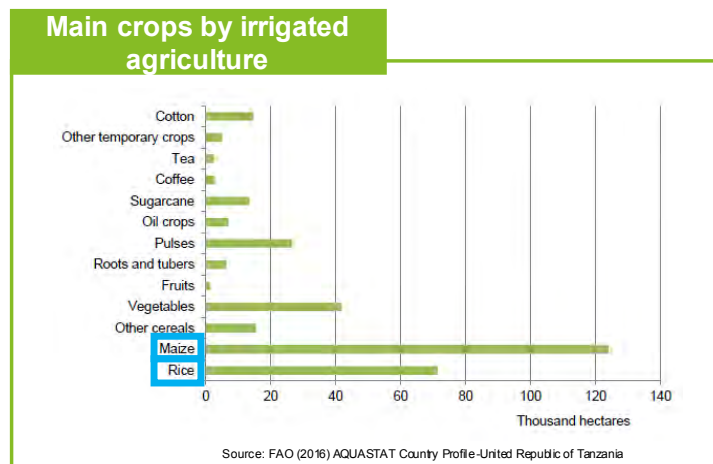
Figure 2-61　Main crops by irrigated agriculture

Issues in irrigated agriculture

In Tanzania, the main challenges are the lack of irrigation infrastructure, knowledge of irrigation engineers, data collection systems and monitoring tools.
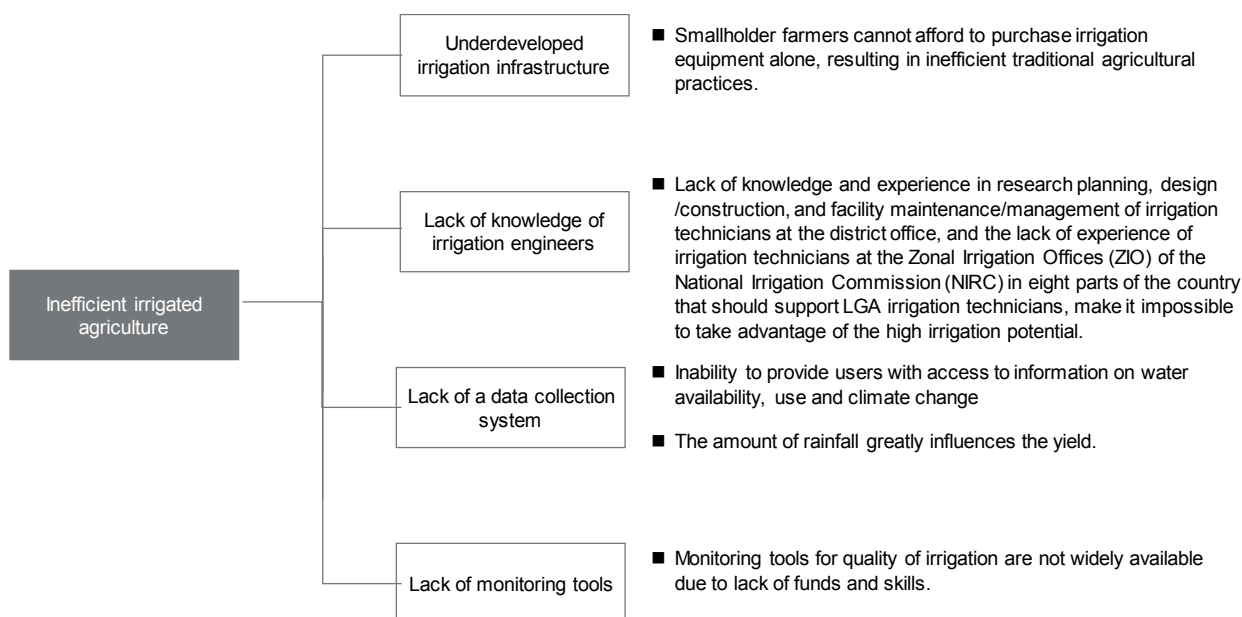
Figure 2-62   Issues in irrigated agriculture

Related stakeholders

As shown in the following table, many stakeholders in water/irrigation and agriculture at the ministry level are involved in agricultural irrigation in Tanzania.

Table 2-28   Stakeholders related to irrigated agriculture

Ministries and related organizations	Role
Ministry of Livestock and Fisheries	Responsible for policy-making including the National Irrigation Act, monitoring and evaluation, and involvement of stakeholders in the irrigated agriculture sector
Ministry of Water and Irrigation	Responsible for policy-making, monitoring and evaluation, human resources development and research on water and irrigation
National Environmental Management Council	Functions as an advisory board to the government in the environmental field, including agriculture
National Water Board	Responsible for strategic advisory for the Ministry of Water and Irrigation
National Irrigation Commission	Responsible for planning and promoting irrigation
Ministry of Agriculture	Responsible for policy-making, monitoring and evaluation of agriculture, and involvement of stakeholders in irrigated agriculture
Basin Water Board	Nine branches in the country, authorized to give permission to allocate and use water under the direction of the Ministry of Water and Irrigation and responsible for water management at the local level
Water User Association	Responsible for supervising community-level water governance under the Basin Water Board
Tanzania Meteorological Agency	Implementation of sanitation services and data collection in the water sector in collaboration with other organizations

(2)   Recent cooperation by JICA and other donors

JICA has been supporting the Agricultural Sector Development Program (ASDP) since its inception and has been supporting Tanzania's agricultural development from many angles through both financial and technical cooperation. JICA also has extensive experience in planning and technical assistance in the irrigation sector.

Table 2-29　Cooperation in the field of irrigationa and agriculture in recent years

Project Name	Scheme	Period	C/P	Overview
Rice Development Support Project	Technical project	2012-2019	Ministry of Agriculture	The project aimed to disseminate techniques for irrigated rice cultivation throughout the country through training. Furthermore, as it is necessary not only to expand irrigated rice cultivation but also to promote rain-fed field rice cultivation and rain-fed lowland bogs rice cultivation, training methods were developed to disseminate rain-fed rice cultivation techniques (including fields and lowland bogs). Strengthened training on the rice industry value chain, including not only production but also post-harvest processing and marketing.
Small-Scale Irrigation Development Project	For value	2013	Ministry of Agriculture	The project aimed to improve agricultural productivity, mainly rice, through construction of new irrigation facilities, renovation of existing facilities and procurement of related equipment in mainland Tanzania, thereby contributing to improved livelihoods and poverty reduction of smallholder farmers
Capacity development project for promoting the District Agricultural Development Project (DADP) Phase 2	Technical project	2015-2019	Ministry of Water and Irrigation, National Irrigation Commission	The project aims to improve the capacity of irrigation engineers and establish a mechanism to improve and promote irrigation development projects based on the CGL by improving the Comprehensive Guidelines (CGL) and related manuals developed for irrigation engineers in ZIOs and LGAs, which will contribute to the promotion of irrigation development projects and rice production increase, and ultimately contribute to poverty reduction in rural areas.
Project for Capacity Development of Agricultural Periodic Data System in ASDP	Technical project	2015-2019	ASDP M&E Working Group	Agricultural Sector Development Program (ASDP) was developed and an Agricultural Routine Data System (ARDS) was established as a tool for monitoring and evaluating ASDP. Strengthening the operational structure of the ARDS data at the central and local levels, and facilitating its use, will allow the government to quickly assess the status of the agriculture sector, thereby contributing to strengthening its strategic policy-making and implementation capacity.
Revision of the Master Plan for Nationwide Irrigation	Technical project	2016-2018	Ministry of Agriculture	Through this cooperation, Japan will promote the more stable and sustainable development of irrigation through the revision of the NIMP, and contribute to improving the productivity of rice-based agricultural products, economic growth, and poverty reduction.
Project for Capacity Development for the Implementation of the District Agricultural Development Plan through the SHEP Approach	Technical project	2019-2023	Ministry of Agriculture	By establishing the SHEP approach (TANSHEP) in Tanzania in the horticultural priority areas of the government, implementing the TANSHEP under the District Agricultural Development Plan (DADP) in the priority local administrative areas, and supporting the planning and implementation of DADP in the horticultural priority areas by the central government, the project supports DADP work to increase agricultural income of horticultural farmers in the target areas, and contributes to the improvement of agricultural income by DADP which incorporates TANSHEP.

Source: JICA Survey Team

International organizations have begun to manage irrigated agriculture using satellite data.

Table 2-30　Support from other donors in the field of irrigated agriculture

Donors, etc.	Project Name	Period	Overview
USAID	Feed the Future Programme	2016-2020	Collaborative research, policy advisory, enhanced advocacy, human resources development, and public relations for effective policy and programming in the agricultural sector in Tanzania. Contributed to the expansion of private investment by establishing a department in the Ministry of Agriculture and the Ministry of Livestock and Fisheries
AGRA	Bread Basket Initiative	2017-2021	Facilitation of the government of Tanzania's policy formulation in the agricultural sector, strengthening of the agricultural supply chain through platforms, improvement of crop quality and added value, and introduction of technologies that contribute to increased shipments of crops
IFAD	Marketing Infrastructure Value Addition and Rurual Finance Support Programme	2011-2018	It aims to realize poverty reduction and economic growth in rural areas through improvements in income and food security in rural areas. Increased productivity by opening access to financial services and markets.
WFP	WFP Innovation Hub	2018	In order to contribute to the achievement of SDGs 2 (hunger and nutrition) and 17 (partnership) by the World Food Programme (WFP), the WFP Innovation Hub was established in 2018 to promote innovation by international organizations, NGOs, and private companies including startups. The Hub provides WFP's expertise in field logistics and IT while supporting local startups, hosting innovation boot camps, and implementing pilot projects.
FAO	WaPOR Open-Access Database	2017	WaPOR is a system that uses satellite data and Google Earth's throughput to map how much biomass and harvest are available for water consumption. It achieved a resolution of 30-250 meters and update every 1-10 days.
Ministry of Agriculture, Forestry and Fisheries of Japan	JASMAI	2020	An information system called JASMAI, which provides weather information for agriculture, such as weather and solar radiation, based on data from Japan's earth observation satellites is being built. In the future, the system will be transferred to the Ministry of Agriculture, Forestry and Fisheries (MAFF) for use in harvest forecasting. MAFF will work with researchers to organize the relationship between weather data and grain yields, and create a system for forecasting crop performance during the harvest season using satellite data.

Source: JICA Survey Team

(3) Applicability of various digital technologies

As mentioned above, in Tanzanian agriculture, challenges exist in each process of the value chain: production, manufacturing, processing, distribution, sales, and consumption. Bottlenecks to the challenges exist in each process, but in general terms, the old ways of doing things may not be able to cope with the rapid increase and diversification of demand. Therefore, the use of ICT is desired as a solution to build a value chain to transport more crops and agricultural products safely, quickly, and inexpensively. With regard to irrigation, the following issues have been identified: inadequate irrigation infrastructure, lack of knowledge among irrigation engineers, lack of data collection systems, and lack of monitoring tools. The bottlenecks for each of these issues may be the lack of educational opportunities for technicians and the lack of new systems and tools, so it is desirable to consider the use of ICT systems with low hurdles for implementation to solve these problems.

Accordingly, we have summarized the information, including the name of companies, their services, and an outline of their advantage, of digital technologies which may contribute to increasing the efficiency of agriculture and irrigation in Tanzania as follows.

Example of ICT solutions (1)

Aerobotics is developing a monitoring system that uses ICT to manage crop risks from the sky using satellites and drones.

Company name	Aerobotics
Head office	South Africa
Establishment	2014
Number of employees	-
Investment stage	-
Deployment	Uganda and Asia (especially Laos)

Service overview	Monitoring crop health using drones and satellites. On-line data to visualize health status of all crops
Advantage	✓ Monitoring the health status of crops from above can lead to early detection of unhealthy crops ✓ Focusing on crops that need treatment enables significant savings in time and cost

Figure 2-63   Monitoring crop health using drones and satellites

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (2)

Saka no Tochu is developing a matching platform for production management and sales of value added organic agricultural products.

Company name	Saka no Tochu
Head office	Kyoto, Japan
Establishment	2004
Number of employees	About 40 employees
Investment stage	¥851 million
Deployment	Uganda and Asia (especially Laos)

Service overview	Organic agricultural production management, matching between producers and buyers IT system to support the provision of opportunities and the optimization of ordering
Advantage	✓ Supporting cultivation planning based on market needs, networking farmers with low-volume, unstable production, and providing production and marketing know-how to support stable supply and market development ✓ Establishment of an self-reliant agricultural model to increase the income of organic producers by cultivating markets and increasing the added value of products.

Figure 2-64   Organic agricultural production and marketing matching system

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (3)

Kobo360 is developing app service like Uber but for trucks, for matching carriers with companies that have cargo transportation needs.

Company name	kobo360
Head office	Nigeria
Establishment	2017
Number of employees	-
Investment stage	Fund raised: $1.2 million
Deployment	Nigeria Planning to expand to Togo, Cote d'Ivoire, Ghana and Senegal in the future

Service overview	On-demand matching of SMEs, freight carriers, and forwarding agents with transportation needs on apps
Advantage	✓ Avoiding intermediaries between shippers and drivers reduces high distribution costs. ✓ Reduce lost opportunities resulting from returning empty after delivery

Figure 2-65   Platform for matching SMEs, freight carriers, and forwarding agents

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (4)

MARS Company is developing a system to add value to agricultural and marine products by introducing advanced refrigeration and storage technology, with the aim of providing refrigeration technology that contributes to harvest loss.

Company name	MARS Company		Service overview	Development and sales of products that use unique refrigeration technology to create an environment in which fresh foods are not frozen even under freezing temperatures and to preserve freshness
Head office	Gunma, Japan			
Establishment	2006			
Number of employees	-		Advantage	✓ Kuraban, which preserves three to ten times the freshness of conventional refrigerators without freezing ingredients
Investment stage	¥99 million			✓ Sea snow, a snow-like ice that greatly improves fish shelf life and reduces transportation costs
Deployment	Expanded operations to South Korea and Morocco			✓ Adopted as JICA's popularization and demonstration project in 2017

Figure 2-66   Supplying refrigeration technology that contributes to reducing the harvest loss

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (5)

Twiga Foods is developing a mobile-based produce distribution platform that connects farmers and retailers at a reasonable price.

Company name	Twiga Foods		Service overview	Providing a distribution platform to connect farmers and retailers to open agricultural markets
Head office	Kenya			
Establishment	2014			
Number of employees	300 (estimated)		Advantage	✓ Delivering about 3,000 outputs a day through a network of 17,000 farmers and 8,000 vendors
Investment stage	-			✓ Use M-Pesa mobile money to settle via mobile applications and to coordinate product exchanges
Deployment	Kenya			✓ Procurement of ¥1.1 billion from IFC of the World Bank Group, a private equity fund TLcom, GAFSP (Global Agriculture and Food Security Programme), and other organizations

Figure 2-67   Mobile-based B2B agro-distribution platform

Source: JICA Survey Team based on the website of the company concerned

Examples of ICT solutions (6)

Routrek Networks has developed a system that automatically controls the optimal amount of irrigation and fertilization based on algorithms and the cultivation environment (solar radiation and soil moisture).

Company name	Routrek Networks, Inc.		Service overview	ZeRo.agri collects environmental information in the greenhouse using soil sensors and solar radiation sensors. Data is analyzed in a cloud that is constantly connected, and water and fertilizer cultures are automatically supplied to meet the environment of the day.
Head Office	Kanagawa, Japan			
Establishment	2005			
Number of Employees	About 20		Advantage	✓ Automation of irrigation and fertilization ✓ The highest level of precision and low-volume multiple irrigation ✓ Environmental data such as soil moisture content, soil EC values, weather forecasts, solar radiation, and land temperature, as well as cultivation data such as irrigation and fertilizer application, are monitored from outside the field using PCs and smartphones. ✓ Data and storage of all information, from climate and soil conditions to crop growth
Investment stage	¥443,192,447 (including capital reserves)			
Deployment	Sold products to 132 sites in 30 prefectures in Japan (as of December 2018) Overseas market includes Vietnam, Thailand, and China.			

Figure 2-68　ICT-based next-generation culture soil cultivation system

Source: JICA Survey Team based on the website of the company concerned

Examples of ICT solutions (7)

NEC is developing a system that uses advanced technology to acquire various data and provide optimal farming advice in virtual fields.

Company name	NEC Corporation		Service overview	Optimization of water, fertilizer, agricultural chemicals, etc. and maximization of yields in accordance with crop growth conditions and weather conditions
Head Office	Tokyo, Japan			
Establishment	1899			
Number of Employees	20,252 employees (unconsolidated)		Advantage	➤ Based on data obtained from weather and soil sensors, satellites, drones, etc., and data obtained from farming environments such as irrigation and fertilization, a virtual farm is generated on a computer. Based on a simulation of growth on the virtual farm, an optimum farming advice and a forecast of yield and harvest timing are made accordingly.
Investment stage	¥397.2 billion (as of March 31, 2019)			
Deployment	It has a wide range of operations in EMEA, Greater China, APAC, North America, and Latin America and also has local subsidiaries.			

Figure 2-69　Improving crop yields and cultivation efficiency

Source: JICA Survey Team based on the website of the company concerned

Examples of ICT solutions (8)

Sun Corporation is developing a system that uses a platform to manage data in real time and control optimal irrigation.

Company name	SUNCORPORATION
Head Office	Aichi, Japan
Establishment	1971
Number of Employees	1,013 employees (consolidated)
Investment stage	¥1.009 billion (as of March 31, 2019)
Deployment	13 bases in the U.S., Europe, Southeast Asia, China, and Oceania

Service overview	Real-time monitoring of environmental information such as temperature, humidity, CO2 concentration, and solar radiation in the greenhouse from a remote location
Advantage	✓ Bacsoft IoT Platform allows farmers to easily and inexpensively improve and optimize agricultural processes ✓ Real-time fault detection, data transfer from meteorological stations, humidity and temperature monitoring in remote and wireless applications, and water distribution system adjustment ✓ The long-life battery power supply with an optional solar panel connection is available at remote locations without power supply

Figure 2-70 Cloud-based irrigation management and IT agriculture

Source: JICA Survey Team based on the website of the company concerned

Examples of ICT solutions (9)

SunCulture is developing a system to improve the productivity of small-scale farmers with off-grid solar-powered irrigation systems.

Company name	SunCulture
Head Office	Kenya
Establishment	2012
Number of Employees	-
Investment stage	-
Deployment	Kenya, Rwanda, Somalia, Tanzania, Uganda, Zambia, Ethiopia

Service overview	Off-grid solar irrigation systems and associated installation training, financial services, and cultivation technology services for small-scale farmers
Advantage	✓ Product design from the viewpoint of improving farmers' efficiency and productivity. The company's drip irrigation system saves 80% of the existing system ✓ Expand its service lines in line with farmers' value chains ✓ A 'Pay-As-You-Grow' scheme is in place to ensure that small-scale farmers can invest in facilities to ensure that productivity growth is not hindered by lack of capital

Figure 2-71 User-based off-grid solar irrigation systems

Source: JICA Survey Team based on the website of the company concerned

(4)   Potential OI themes

As a result of discussions with JICA Tanzania Office, it was confirmed that the OI theme would be selected from among the agriculture and irrigation sectors, based on the diversity of local and national players and solutions, etc., and also on the premise of possible collaboration with the TANSHEP project.

2.5.2   Improving rural financial inclusion

(1)   Current status and issues in rural financial inclusion

The financial inclusion rate in Tanzania has improved significantly due to the strengthening of private-sector partnerships in financial inclusion by the government. Financial Inclusion indicates to possess a government certified financial institution acount and to receive any form of finanicial service.

Current status of financial inclusion

> Financial inclusion rate in Tanzania have increased from 50% in 2014 to 56% in 2017.

> The number of people using informal financial services fell from 29% to 7%, and the number of people using formal financial services quadrupled

> The improvement in figures was driven by the emergence of financial services using ICT platforms. This can be attributed to a relaxed regulatory environment (National Financial Inclusion Framework 2014-2016 and 2018-2022), private investment and ecosystem
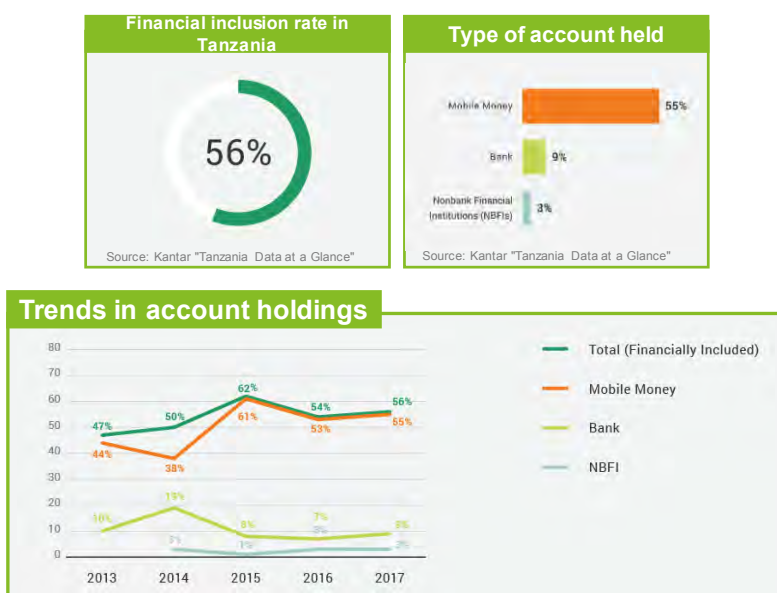
Figure 2-72   Current state of financial inclusion[1]

Source: Kantar "Data at a Glance"

Government initiatives

The government of Tanzania has introduced following policies for financial inclusion.

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[1] The graph represents the population in Tanzania above 15 years old.

Table 2-31 Government initiatives

#	Policy document	Details
1	National Financial Inclusion Framework 2018-2022	Following the previous National Financial Inclusion (NFIF) 2014-2016, a new policy to promote financial inclusion was launched. It aims to build a comprehensive and effective financial system by promoting stakeholder collaboration between the public and private sectors.
2	National Microfinance Policy 2017	It outlines an environment development that promotes microfinance. Its aim is to contribute to economic growth, job creation and poverty reduction, with a particular focus on low-income individuals, households and micro-enterprises.

Source: JICA Survey Team

Challenges in financial inclusion in rural areas

Rural financial inclusion rates are much lower than in urban areas because of poor financial knowledge and lack of appropriate services for rural areas. The challenges include the following.

➤ The Tanzanian population without access to finance remains high at 54%, many of which are rural areas, small-scale farmers, young people and women.

➤ Although 72% of urban areas have access to the financial system, it is 48% or less in rural areas.

➤ The financial inclusion rate of the poor is 50%, while that of the non-poor is 77%. The poor have limited access to finance.

➤ Women have less access to finance than men, and 9% of women use informal financial services.
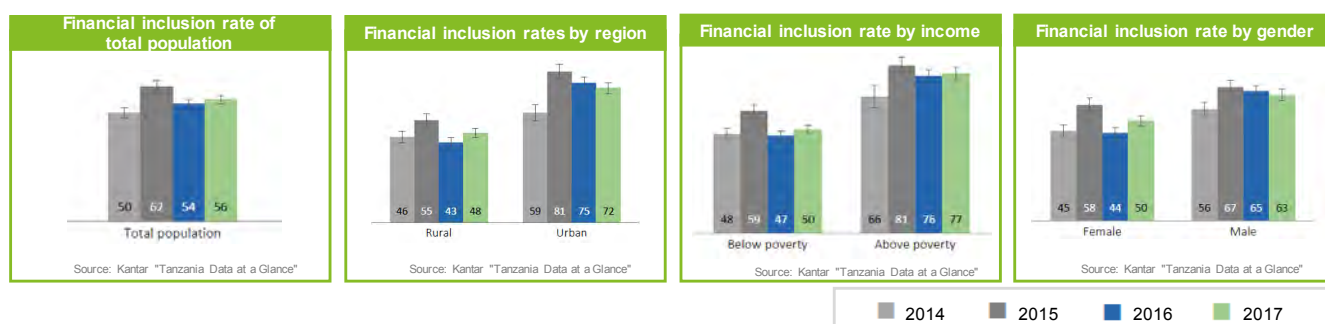
Figure 2-73 Status by attribute[2]

Source: Kantar. "Tanzania Data at a Glance"

Analysis of issues in financial inclusion

According to the desktop research, the Low financial inclusion rate in rural areas may be attributed to the following

① Lack of appropriate services for rural users

② Lack of appropriate services for rural users

③ Strict conditions for the use of financial services (collateral, etc.) in rural areas

④ Cash and informal sector dominate in rural areas

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[2] The graph represents the population in Tanzania above 15 years old.

(2) Recent cooperation by JICA and other donors

JICA has been conducting a cooperation preparatory survey on financial promotion projects for small and medium manufacturers in Tanzania, and has also conducted a FinTech survey in Africa. Research on FinTech is not directly related to Tanzania, however, covers several services that operate in the country and also analyses similar issues in financial inclusion.

Table 2-32   Recent Assistance Projects in the Financial Inclusion Sector

#	Project Name	Scheme	Period	C/P	Overview
1	Finance Promotion Program for fostering small and medium-sized manufacturers, etc.	Preparation for cooperation	2017-2019	Ministry of Finance and Planning	This cooperation preparatory survey was conducted to collect and analyze information on the "finance promotion program for fostering small and medium-sized manufacturers, etc." aimed at providing financial access to small and medium-sized manufacturing enterprises, and particularly low-interest, medium-and long-term loans conducive to capital investment, to confirm the implementation structure, and to prepare proposals for implementation. The purpose of this loan is to contribute to the sound development of the domestic industry and economy by providing concessional medium-and long-term loans through two-step loans (TSL) to stimulate finance mainly for small and medium-sized manufacturing companies and expand capital investment and production.
2	Research on the use of FinTech in agricultural finance in developing countries	Basic information gathering and confirmation survey	2019	-	The purpose of this report is to analyze the possibility of promoting ICT access to finance and agricultural index insurance in agriculture and rural development, and to advise on opportunities and possibilities for entry by Japanese companies (especially SMEs). The three countries surveyed were Ethiopia, where agricultural index insurance is already being sold on a trial basis; Uganda, where weather index insurance has been implemented and the conditions for mobile money users are high and the communication environment is good; and Africa, where the communication environment is good and ICT is a leading country.

Source: JICA Survey Team

Following table shows the recent ICT-related projects by other donors supporting financial inclusion.

Table 2-33   ICT-related projects of other donors in the area of financial inclusion in rural areas

#	Donors, etc.	Project Name	Period	Overview
1	World Bank	Universal Financial Access 2020 Initiative	2015-2020	The UFA2020 Initiative aims to realize the possession of IT devices that enable both women and men to hold financial accounts, savings, remittances and deposits. Under the World Bank's leadership, establishing regulatory environments, increasing access points, developing government-led programs and promoting the introduction of IT are in progress.
2	African Development Bank	Africa Digital Financial Inclusion Facility	2019	It is a multi-agency fund for the digitization of finance and is currently invested by the Bill and Melinda Gates Foundation, the Government of Luxembourg, and a French development agency. Funds are used to develop regulatory environments, build digital payment systems, disseminate digital IDs, promote e-government, promote innovation, and develop human resources.

Source: JICA Survey Team

(3) Applicability of various digital technologies

As mentioned above, the challenges to increasing financial inclusion in rural Tanzania were hypothesized to be a lack of services suitable for rural users, conditions for using financial services (collateral, etc.) that are too strict for rural areas, and persistent cashism and informal sector. In order to address these issues, we compiled information on individual case studies of digital technologies that could contribute to promoting financial inclusion in rural Tanzania. The names of the companies, an overview of their services, and a summary of their advantages are given below.

Example of ICT solutions (1)

Nippon Biodiesel Fuel is developing a smartphone application service for agricultural cooperatives.

Company name	Nippon Biodiesel Fuel Co., Ltd.
Head office	Kanagawa, Japan
Establishment	2000
Number of employees	-
Investment stage	¥50 million (as of March 2019)
Deployment	Mozambique

Service overview	Using the electronic agricultural cooperative platform, match farmers with material sellers at a distance, and provide services such as time deposits and micro-credit to farmers in apps.
Advantage	✓ Collaboration with WFP ✓ Matching farmers and buyers who want to purchase agricultural products ✓ Intermediation between farmers and manufacturers of agricultural materials who want to sell fertilizers and seeds ✓ In addition to small loans, the company collects purchase history and credit information. In addition to e-money, payments are made through mobile money of three major mobile operators in the country as well as bank accounts.

Figure 2-74 Electronic agricultural cooperative platform to match farmers with buyers

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (2)

myAgro is developing a scratch-card mobile deposit service that can be used to purchase small amounts of fertilizer, seeds, and training opportunities.

Company name	myAgro
Head office	Senegal
Establishment	2008
Number of employees	-
Investment stage	-
Deployment	Mali and Senegal

Service overview	A scratch card system similar to mobile phone credit allows users to purchase fertilizer, seeds, and training opportunities at small prices.
Advantage	✓ Mobile savings services for agricultural materials using scratch cards, which are familiar to the poor. Encourage to achieve deposit targets by buying a small amount of scratch card and depositing it in a mobile account ✓ It is characterized by the large number of female customers (65%).

Figure 2-75 Mobile saving services using scratch card

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (3)

Kitovu is using ICT to connect farmers with buyers, fertilizer and pesticide advice, and to develop matching solutions between farmers and financial services in Nigeria.

Company name	Kitovu
Head office	Nigeria
Establishment	2016
Number of employees	-
Investment stage	-
Deployment	Six states in Nigeria

Service overview	Collect soil and geographical data on farmland and provide advice on fertilizer and pesticides appropriate to each condition. Match farmers with buyers and financial institutions.
Advantage	✓ Farmers' yield increased by 300% ✓ The company received awards for innovation and agriculture both in the country and overseas ✓ The company been working in six Nigeria states and helping more than 10,000 farmers

Figure 2-76   Solution to connect farmers to financial services

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (4)

Tala is developing a service to provide small loans to low-income people by using their smartphone usage history for credit screening.

Company name	Tala
Head office	Kenya
Establishment	2015
Number of employees	-
Investment stage	-
Deployment	Kenya, Mexico, India and the Philippines

Service overview	Provide loans based on the usage and payment history of the consumer's android terminal as a data source for credit screening
Advantage	✓ The main credit line is a small loan of $10 to $500, targeting low-income groups. ✓ Since its inception in 2011, Tala has provided loans to more than 1.3 million people in Kenya, totaling $300 million (about ¥33 billion). ✓ By collecting more than 10,000 data points from a smartphone within one minute, the repayment capacity and willingness of its owners can be measured.

Figure 2-77   Using smartphone usage records for credit screening

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (5)

JUMO is developing a service to provide loans and insurance by using data provided by mobile companies for credit screening.

Company name	JUMO
Head office	South Africa
Establishment	2015
Number of employees	-
Investment stage	-
Deployment	Business locations in Kenya, India, Portugal, the U.K. and Singapore Market expansion in Ghana, Tanzania, Kenya, Uganda, Pakistan, and Zambia

Service overview	Provide loans based on mobile data provided by mobile phone companies when conducting credit screening
Advantage	✓ The company received a $52 million (¥5.7 billion) capital increase led by Goldman Sachs in 2018. ✓ It created JUMO Score using data held by mobile communications services providers to enable financing by own or partner banks. ✓ It has provided services to more than 10 million consumers and loans of more than $1 billion to date. ✓ It also provides insurance

Figure 2-78   Using data provided by mobile phone companies for credit screening and matching users with financial institutions

Source: JICA Survey Team based on the website of the company concerned

2.5.3   Increasing the efficiency of Tanzania Revenue Authority staff training

(1)   Current status of tax administration

In Tanzania, while streamlining of tax collection systems, etc. contributes to increased tax revenues. However, improving the level of tax administration capacity remains an issue to be addressed.

Current status of tax administration

➢ In Tanzania's Second Five Year Development Plan (2016-2020) formulated in June 2016, the government set a revenue target of 17.1% of GDP in 2020. In order to increase revenues, the government will strengthen the collection of taxes such as value-added tax and excise tax, impose taxes on the informal sector, expand the geographic tax base, and review tax exemptions and deductions.

➢ However, although the government's revenue has been increasing in recent years, the ratio of tax revenues to GDP is still 13.5% (FY2013), which is not sufficient.

➢ The Tanzania Revenue Authority (TRA) has been working to strengthen its tax administration capacity under the Tax Modernization Program launched in 2003. However, while the Tax Administration Diagnostic Assessment Tool conducted by the IMF in April 2016 highly evaluated the promotion of electronic payments and the efficiency of the collection system, it pointed out that the level of tax administration capacity of the TRA is low in other areas.

Government initiatives

The government of Tanzania has introduced following policies for tax administration.

Table 2-34   Government initiatives for tax administration

#	Policy document	Details
1	Fourth Organizational Plan for TRA	The plan, to be applied from FY2012 to FY2016, aims to increase the government's tax revenue share of total revenues from 61% to 70%. In addition to expanding the tax base by encouraging taxpayer registration, the plan also focuses on tax examinations in certain high-impact sectors, such as agriculture, manufacturing, energy, services (including tourism, communications, and transportation), and natural resources, aiming to increase tax revenues, and improvement of operational efficiency to increase tax revenues. To achieve this, there is a need to strengthen research capacity in specific sectors and improve overall business skills and practices. There are still many challenges to be addressed.

Source: JICA Survey Team

(2)   Recent cooperation by JICA and other donors

JICA has continuously provided support from training for ITA instructors and improvement of training programs to the development of TRA organizations

Table 2-35   Recent assistance projects in the field of tax administration

#	Project Name	Scheme	Period	C/P	Overview
1	Project for Strengthening Tax Training Capabilities	Technical project	2012-2016	TRA	A technical assistance project to strengthen the capacity of the Institute of Tax Administration. The project systematized the planning and preparation process of the training project, increased the capabilities of the ITA instructors to implement the training, and strengthened the evaluation procedures. On the other hand, the project also suggested the issues facing human resources development, such as linking training and human resources, responding to more specialized content and advanced knowledge, and institutionalizing on-the-job training to acquire skills rooted in practical work.
2	Project for Capacity Development in Tax Administration	Technical project	2017-2020	TRA	The project aims to contribute to the strengthening of TRA's efforts to improve human capacity for continuous, effective and appropriate tax execution with the aim of increasing domestic revenues by improving ITA's training program, strengthening the coaching and mentoring program by the human resources and general affairs departments, and improving the career development framework by level and specialty to strengthen institutional capacity to address the skill gaps in the TRA.

Source: JICA Survey Team

There are no confirmed cases of ICT utilization by other donors, while support is being provided for improving tax examination capabilities as follows.

Table 2-36   Other donor-related projects in the field of tax administration

#1	Donors, etc.	Project Name	Period	Overview
1	DfID (U.K.) and others	Tax Modernization Programme (TMP) Phase 4	2013-2018	In addition to contributions to the basket fund, technical assistance was provided through the dispatch of British government officials.
2	United States Department of Treasury	TRANSFER PRICING TECHNICAL ASSISTANCE	2011-	The project provides hands-on assistance to strengthen the capacity of tax examinations of multinational enterprises on transfer pricing taxation and tax examinations of specific sectors such as construction and tourism industries, etc.

Source: JICA Survey Team

(3)   Applicability of various digital technologies

As mentioned above, with regard to the Tanzania Revenue Authority, the low level of tax administration skills of its staff has been identified as an issue, and improving the quality of its training would contribute to solving the problem. On the other hand, the bottleneck is that improving the quality of training is costly and time consuming. Therefore, we have compiled information on individual case studies of digital technologies that are expected to contribute to the efficient improvement of training. The names of the companies, an overview of their services, and a summary of their advantages are given below.

Example of ICT solutions (1)

Academic Bridge is a Rwandan venture company that provides a platform for IT management in education, and is introducing ICT into the education sector.

Company name	Academic Bridge
Head office	Kigali, Rwanda
Establishment	2014
Number of employees	14
Investment stage	-
Deployment	Rwanda

Service overview	✓ **Management software that enables schools to manage, analyze, process and share student data** ✓ **Communication tool between relevant parties in education (schools, students, parents)**
Advantage	✓ Sophisticated customization to meet customer needs ✓ UI/UX ✓ Price

Figure 2-79   Introducing ICT to the field of education

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (2)

Ceed Learning is a venture company from South Africa that is implementing e-learning and providing online courses and other content.

Company name	Ceed Learning (Pty) Ltd
Head office	Johannesburg, South Africa
Establishment	2019
Number of employees	14
Investment stage	-
Deployment	South Africa

Service overview	**Introduces e-learning and provide content such as online courses.** Also builds a platform for learning systems and support capacity building. **Develops mobile applications as well.**
Advantage	✓ Providing integrated services such as planning of learning strategies, management improvement through digital learning and digitization, construction of platforms and capacity building ✓ Also developing learning applications for smartphones ✓ Participation in many international conferences on e-learning and innovation in learning technologies

Figure 2-80   Introducing IT contents and supporting capacity building in the field of education

Source: JICA Survey Team based on the website of the company concerned

(4)   Potential OI themes

Based on discussions with JICA Tanzania Office, the team has decided to drop the topic as the solution options are limited compared to agriculture.

2.6   Mozambique

2.6.1   Improving efficiency of primary education

(1)   Current status and issues in primary education

In primary education in Mozambique, the shortening of teacher training periods and the diminishing capacity of teachers due to the employment of unqualified teachers have become problems, and the strengthening of the capacity of new and in-service teachers is an urgent issue to be addressed. The issues and current situation are presented below.

➢ The government of Mozambique has intensively worked on improving access to primary education, which is one of the MDGs, and as a result of improving access by increasing the number of schools, providing free primary education, and free textbooks, the net enrollment rate of 95.5% was achieved in 2010.

➢ On the other hand, there is a serious shortage of school infrastructure and teachers compared to the rapid increase in the population eligible for basic education, and the development of an education system that contributes to improving the level and quality of education is an issue.

➢ Furthermore, due to the expansion of access to primary and secondary education, the number of students per class has been rapidly increasing. The expansion of school facilities is another urgent task.

Following ICT-related policy has been implemented by the government of Mozambique in the area of primary education.

Table 2-37   Government Initiatives (ICT-related)

#	Policy document	Details
1	Education Technology Plan (PTE)	Under this plan formulated in 2011 by the Ministry of Education Development, the Mozambique government aims to utilize ICT focusing on the following three points: (1) teachers' management from pedagogical perspectives; (2) school management; and (3) learning tools for both teachers and students. It also pushes forward developing children's' textbooks; management of schools and teachers; ICT for teachers training ; e-learning platforms for correspondence education.

Source: JICA Survey Team

(2)   Recent cooperation by JICA and other donors

JICA implements support for primary education mainly focusing on teachers training.

Table 2-38　Recent cooperation in primary education

#	Project Name	Scheme	Period	C/P	Overview
1	Project for Expansion of New Curriculum of Teacher Training Institute (IFP)	Technical cooperation project	2015-2020	Ministry of Education and Human Development	This project aims to help instructors at IFPs improve their teaching abilities and knowledge as well students at IFPs (who are future elementary school teachers). For this purpose, the project develops teaching materials for mathematics and science that are to be used in teacher training courses, and disseminats them to IFPs throughout the country. By this attempt, it is expected that students at IFPs improve their abilities to teach mathematics and science. In addition, through this project, JICA contributes to the development of core human resources who are responsible for the creation of teaching materials in Mozambique by transferring technology to the National Institute for Educational Development (INDE).
2	Project for Expansion of New Curriculum	Technical cooperation project	2021-2027	Ministry of Education and Human Development	Through this project, the Ministry of Education and JICA aim to improve the academic performance of Mozambican children in math and science by revising math and science curricula and textbooks, training teachers, in-service teacher training, and strengthening the educational evaluation system.
3	Project for Construction of Primary Teacher Training Center	Grant aid	-	-	As a cooperation through grant aid, JICA constructed primary teacher training centers in Xai-Xai, Chimoio, and Monapo in Nampula Province.
4	The Project for the Construction of Secondary Schools in Zambezia Province	Grant aid	2019-	-	In Zambezia Province, the project will improve the learning environment for early secondary education by constructing new secondary schools, teachers' residences, and other facilities and equipment, thereby contributing to the improvement of access to early secondary education and the quality of learning in the target areas.

Source: JICA Survey Team

Other donors are also supporting the use of ICT in primary education (as in below table).

Table 2-39　ICT-related projects by other donors in the field of education

#1	Donors, etc.	Project Name	Period	Overview
1	GIZ	Basic and Vocational Education and Training	2019-2022	In line with the national education strategy, and the goals of vocational training reform and approaches, this project provides support for educational administration mainly in Sofala Province and Inhambane Province. As part of the project, technical advice on the utilization of IT for school information is also provided. (https://www.giz.de/en/worldwide/20451.html)
2	KOICA	The Republic of Korea's Country Partnership Strategy for the Republic of Mozambique 2016-2020	2016-2020	This project supports enhancing the capability of vocational training schools and improving primary education environment and educational abilities. (http://www.odakorea.go.kr/fileDownLoad.xdo?f_id=1493457144953192168139IGG9UJ38E8H3SRKOGP6V)

Source: JICA Survey Team

(3)　Applicability of various digital technologies

As mentioned above, primary education in Mozambique is facing the challenges of declining teacher capacity and strengthening the capacity of new and in-service teachers, and the bottleneck is considered to be the shortage of teachers due to the rapid increase in the number of students and the lack of efficient teacher training. Therefore, we have compiled information on individual case studies of digital technologies that are expected to contribute to improving the quality of primary education in the country. The names of the companies, an overview of their services, and a summary of their advantages are given below.

Example of ICT solutions (1)

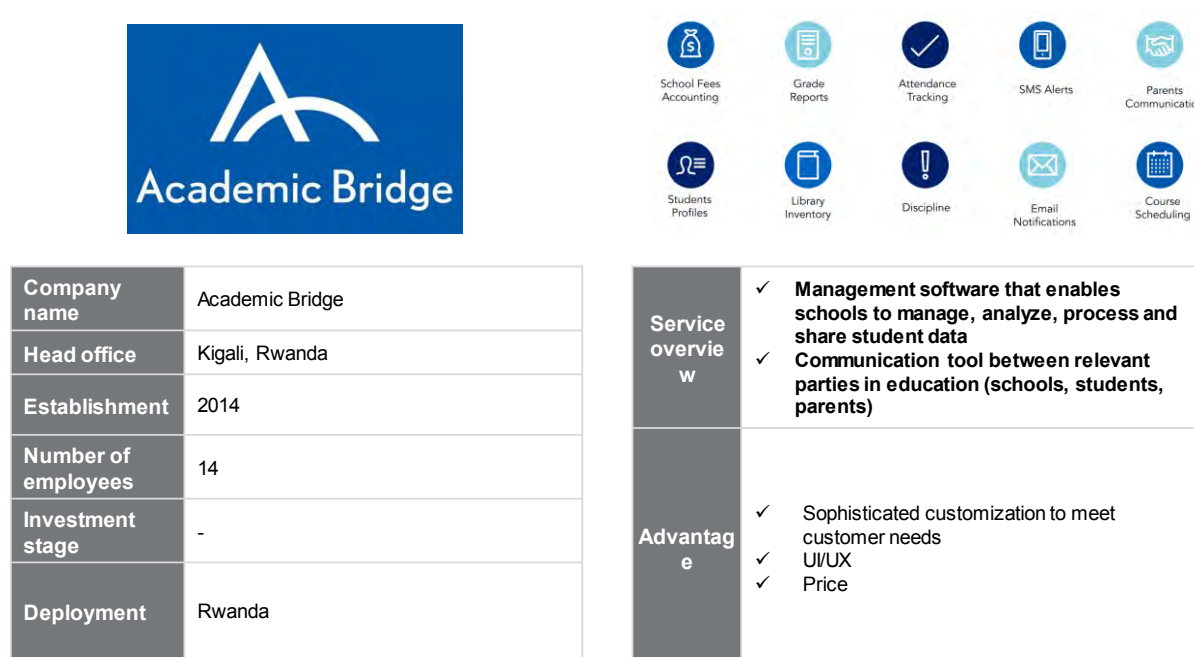Academic Bridge is a Rwandan venture company that provides a platform for IT management in education, and is introducing ICT into the education sector. If implemented in Mozambique, the system could improve the quality of education by streamlining the management of student data by schools and teachers, and communication among education professionals.

Company name	Academic Bridge
Head Office	Kigali, Rwanda,
Establishment	2014
Number of Employees	14 people
Investment stage	-
Country of operation	Rwanda

Service overview	✓ **Provision of management software that enables schools to manage, analyze, process and share students' data** ✓ **Provision of communication tools used among educators (schools, students, parents)**
Superiorities	✓ Sophisticated customization to meet clients' needs ✓ UI/UX ✓ Prices

Figure 2-81   Introducing ICT to the field of education

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (2)

Ceed Learning is a venture company from South Africa that is implementing e-learning and providing online courses and other content. If introduced in Mozambique, the use of e-learning in the classroom may help to homogenize the quality of teaching and allow schools to operate with fewer teachers.

Company name	Ceed Learning (Pty) Ltd
Head Office	Johannesburg, South Africa
Establishment	2019
Number of Employees	14 people
Investment stage	-
Country of operation	South Africa

Service overview	This company **introduces e-learning and provides content such as online courses**. It also builds a platform for learning systems; performs capacity building; **develops mobile applications.**
Superiorities	✓ Providing integrated services such as planning of learning strategies; digital learning; management improvement through digitization; construction of platforms; capacity building ✓ Developing learning applications for smartphones ✓ Participating in many international conferences on e-learning and innovation of learning technologies

Figure 2-82   Introducing IT contents and supporting capacity building in the field of education

Source: JICA Survey Team based on the website of the company concerned

(4)   Potential OI themes

In the field of education, the technical cooperation project " Project for Expansion of New Curriculum of Teacher Training Institute (IFP)" is being implemented until April 2020, and its continuation project " roject for Expansion of New Curriculum" is scheduled from 2021 to 2027. Therefore, the theme under education has a more concrete image compared to other themes. Accordingly, after discussions with JICA Mozambique office, the OI theme on ICT-based learning was selected instead of programming education.

2.6.2   Improving efficiency of health system

(1)   Current status and issues of health system

The current status of the health system in Mozambique is as follows. Especially the development of a system to train medical personnel has become an urgent task.

➢ In Mozambique, health facilities have been developed to improve the access to health services. However, the quality of health services is being seriously affected by a critical shortage in the number and abilities of the medical personnel who provide services at the facilities.

➢ Particularly, there is an urgent need to construct a system to train medical personnel with appropriate knowledge and skills. At the medical worker training schools that train medical personnel (excluding doctors), unified curriculum is yet to be established.

➢ In Mozambique, the percentage of people infected with HIV/AIDS varies greatly from region to region, and further awareness-raising on the prevention of these diseases is an urgent task, especially in areas where infection percentage is high.

Following ICT-related policy has been implemented by the government of Mozambique in health sector.

Table 2-40   Government Initiatives (ICT-related)

#	Policy document	Details
1	Health Sector Strategic Plan (PESS 2014-2019)	With this plan (PESS 2014-2019), the government planned to strengthen ICT-based health information management. A video conference system was introduced, which enabled communication between the central and provincial health departments.

Source: JICA Survey Team

(2)   Recent cooperation by JICA and other donors

JICA has provided support for health systems with a focus on talent development.

Table 2-41   Recent Cooperation in the Health System

#	Project Name	Scheme	Period	C/P	Overview
1	The Project for Construction of Health Science Institute in Maputo	Grant aid	2014		ICS was newly established in Maputo City, and the necessary equipment for human resource development was provided. By expanding the number of medical personnel with appropriate skills, we contributed to improving the quality of health care services.
2	The Project for Construction of Health Science Institute in Nacala	Grant aid	2015		A training school for medical personnel was established, thereby promoting the training of mid-level health personnel and contributing to the improvement of the quality and quantity of health personnel in the country.
3	Advisor on HIV/AIDS Control System Enhancement	Individual Expert	2015-2018	Nampula AIDS Control Committee	In this project, NPCS Gaza and the National Committee for HIV/AIDS (CNCS) provided technical cooperation to disseminate good practices in Gaza Province to people involved in HIV/AIDS control in the Nacala Corridor region, especially in Nampula Province. In this province, the absolute number of people infected with HIV/AIDS is high, and the number of infections is rapidly increasing due to remarkable economic development and a large population.
4	Project for Strengthening Pedagogical and Technical Skills of Health Personnel in Mozambique (ProFORSA II)	Technical cooperation project	2016-2019	Education Division, Human Resources Bureau, Ministry of Health	This project adopts local-based approach through all processes. Through collaborative work with JICA experts, Ministry of Health and pilot provinces established a high-quality of continuing education system for the incumbent health workforce in consideration of the local ownership and continuity. Technology transfer was performed giving high priority to the work process so that each training institution can monitor and evaluate its education performance on its own.
5	Project for Strengthening Maternal and Child Health Services in Healthcare Facilities	Technical cooperation project	2021-2024	Ministry of Health	The project aims to integrate the existing maternal health handbook and child health card into a maternal and child health handbook and use this to develop a model for strengthening maternal and child nutrition services in line with national policies and strategies. In addition, the project will strengthen the capacity and coordination of health care workers and community health workers (known as APEs in Mozambique) to operationalize the model in health facilities and communities.

Source: JICA Survey Team

Other donors are providing support for health system improvement as in below table, although ICT-related project cannot be found.

Table 2-42   Projects by other donors in the field of health system

#1	Donors, etc.	Project Name	Period	Overview
1	World Bank	Government of Mozambique's Primary Health Care Strengthening Program - for - Results	2018-	Grant aid to the Global Financing Facility (GFF). (https://www.worldbank.org/en/news/press-release/2017/12/20/world-bank-injects-105-million-to-improve-primary-health-care-in-underserved-areas-of-mozambique)

Source: JICA Survey Team

(3)   **Applicability of various digital technologies**

As mentioned above, the shortage of the number and capacity of medical personnel in Mozambique has become a problem, and the development of a medical human resource development system is an issue that needs to be addressed. However, since the training of medical personnel is time-consuming and costly, it is expected that ICT technology will be used to efficiently implement the training. This report compiles information on individual case studies of digital technologies that are expected to contribute to improving the efficiency and quality of the health system in Mozambique. The names of the companies, an overview of their services, and a summary of their advantages are given below.

Examples of ICT solutions (1)

Babylon Health has developed a medical diagnosis service using AI chatbots with the aim of creating a world where everyone in the world can receive affordable medical services. If introduced in Mozambique, remote medical diagnostic services could help to eliminate disparities in the level of medical care.

Company name	Babylon Health (babyl in Rwanda)
Head Office	United Kingdom
Establishment	2013
Number of Employees	1,001-5,000 people
Investment stage	Series B $85.3 M (approx. ¥9.4 billion)
Countries of operation	Currently operating in the U.K. and Rwanda, and expecting to start operations in China, the U.S. and the Middle East in the future

Service overview	Medical diagnosis service using AI chat bots • Video call with a doctor and reservation service for a medical institution is available • Test code is issued and with this code, a patient can undergo examination at an affiliated institution • Medicines can be prescribed by a neighboring pharmacy
Superiorities	✓ Rules and regulations are developed in Rwanda ✓ 30% (over 2 million) of the target population (over 16 years old) is covered ✓ 4,500 examinations are handled per day ✓ Compatible to USSD

Figure 2-83　Telemedicine and mobile medical services

Source: JICA Survey Team based on the website of the company concerned

Examples of ICT solutions (2)

Miup is developing a system of AI diagnostic assistance based on a large amount of vital data, with the aim of building a worldwide ecosystem of health management, diagnostic assistance, and disease prevention. If introduced in Mozambique, the remote medical diagnosis service could contribute to eliminating disparities in the level of medical care, just as Babylon did above.

Company name	miup Inc.
Head Office	Tokyo, Japan
Establishment	2015
Number of Employees	-
Investment stage	-
Country of operation	Operating mainly in Bangladesh

Service overview	This company provides remote medical care and medical checkup services utilizing ICT, including AI technology, mainly in developing countries.
Superiority	✓ Besides provision of remote medical care and medical checkup services in urban areas, the company is currently building a system for simple medical checkups and identifying the results of medical interviews using AI that can be provided to those with difficulty in accessing medical care. ✓ As a JICA project SDG, it developed AI based medical checkup and remote medical care assistance systems for the poor.

Figure 2-84　ICT-based telemedicine and medical examination service

Source: JICA Survey Team based on the website of the company concerned

(4)　Potential OI themes

Based on discussions with JICA Mozambique Office, the team has decided to drop the topic as other themes such as education and agriculture has wider options compared to healthcare.

2.6.3　Improving efficiency of agriculture

(1)　Current status and issues of agriculture sector

The current status of agriculture in Mozambique is as follows.

➢ The key to achieving the Poverty SDG (eradication of the absolute poor) and the Food Security SDG (eradication of hunger) in Mozambique is the development of the agricultural sector. In rural areas, where 70% of the total population resides, 95% of the employed people are engaged in agriculture.

➢ Though 96% of all farmers are small-scale family farmers, farmers' income is extremely low because they operate subsistence farming with low input and low productivity; therefore, it is important to improve the agricultural productivity of small-scale farmers and improve their access to markets.

The domestic supply of rice is not covered by domestic production, but it depends on imports. It is important to improve the productivity of rice in this country.

Following ICT-related policies has been implemented by the government of Mozambique in the area of agriculture.

Table 2-43　Government Initiatives in agriculture field

#	Policy document	Details
1	Poverty Reduction Action Plan (PARP) 2010-2014	This plan (PARP) sets out three priority objectives, one of which is to increase the production and productivity of agriculture and fisheries, with a particular emphasis on ensuring the food and nutrition security of rural residents.
2	Strategic Plan for Agricultural Development (PEDSA) 2010-2019	With the vision of "achieving a competitive and sustainable agricultural sector", the strategy focuses on: (1) improving food security and nutrition; (2) enhancing the competitiveness of domestic production and raising farmers' incomes; and (3) sustainable use of natural resources and environmental protection
3	Food Production Action Plan (Plano de Ac çã o Para a a Produce çã o de Alimentos [PAPA])2008-2011	This plan (PAPA) was formulated as a comprehensive plan for increasing food production, including rice production to address the rising international food prices in June 2008. As a foundation of this strategy, it suggests efforts to increase domestic agricultural production in order to improve self-sufficiency and overcome dependence on imported food in preparation for the global food crisis.

Source: JICA Survey Team

Challenges in Mozambique's agricultural value chain

Challenges exist in each process of the value chain in Mozambique's agriculture, and innovation-based solutions are required.

1. Production	2. Manufacturing and processing	3. Distribution	4. Sales and consumption
■ Low productivity due to limited irrigation facilities; delays in the development and dissemination of farming techniques such as introduction of appropriate varieties and fertilizer management ■ Complicated land-use licensing procedures and limited access to finance ■ Lack of funds at producers and inadequate support systems such as financing systems	■ Loss of added value due to shortage of processing facilities such as flour mills and rice mills ➤ Due to a shortage of rice mill facilities, some Mozambique rice is exported to Malawi for processing and re-imported to Mozambique; therefore the import price is more than double the original price. As a result, income that Mozambique should gain from added value is being lost	■ Exports do not grow due to undeveloped roads ■ Transportation costs are high (10-15% of selling prices) ■ Lack of storage facilities has made it impossible to wait for the price to rise in the market and it is sold at a low price ■ There are no means to communicate market price information to individual farmers ■ Selling prices are low because there are no means for mass transportation	■ In the case of maize, the final selling price is about seven times the spot-sale price. In regions where obstacles exist in the development of post-harvest and processing, the income that farmers should receive is replaced by the cost at an intermediate stage. This is one of the reasons why the livelihoods of individual farmers do not improve.

Problem analysis

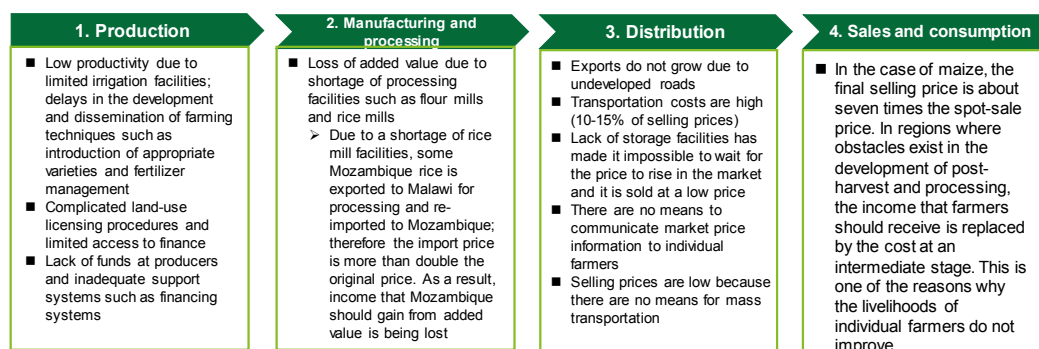By obtaining information, farmers are more encouraged to conduct agricultural production based on the market demand, which will enable them to earn more appropriate profits.

Figure 2-85   Challenges in Mozambique's Agricultural Value Chain

Source: JICA Survey Team

(2)   Recent cooperation by JICA and other donors

JICA has supported agricultural development in Mozambique from many aspects, including the development of the Nacala Corridor and the project to improve rice production.

Table 2-44   Recent Cooperation in the Agriculture Sector

#	Project Name	Scheme	Period	Overview
1	Project for Improvement of Livelihoods of Small Farmers through Establishment of a Virtual Agricultural Market in Mozambique (Collaboration with WFP)	Grant Aid	2020	This project supports the establishment of a virtual agricultural market in Nampula Province in northern Mozambique through WFP, using mobile phones that can grasp the needs of both brokers and farmers at once.
2	Zambezia Rice Productivity Improvement Project	Technical cooperation	November 2016 to November 2021	The main crops are cassava and maize, but demand for rice has been increasing in recent years, particularly in urban areas. While annual rice consumption is increasing, the country depends on imports for the majority of its rice, so it needs to increase domestic rice production. Through this cooperation, JICA supports the dissemination of rice cultivation techniques, improvement of the seed production management system, maintenance and management of irrigation facilities, and strengthening of farmer's organizations in irrigation and rain-fed rice farming areas in Zambezia Province. This will improve rice productivity in the target areas and contribute to increased rice production throughout the province and increased income for rice farmers in the target areas.
3	Project for Establishment of Development Model at Communities' Level with Improvement of Rural Extension Service under Nacala Corridor Agricultural Development in Mozambique	Technical cooperation	May 2013 to May 2019	In Mozambique, about 80% of the workforce is engaged in the agricultural sector, but only 16% of the land is cultivated. In particular, the tropical savannah area in the northern part of the country is blessed with agricultural land with a certain amount of rainfall and a large area; therefore the potential for expanding agricultural production is high in this area. However, agricultural technology is limited and productivity is low. Through this cooperation, JICA contributes to improving agricultural productivity in the target areas such as supporting the establishment of agricultural development models suited to the size of farming operations.
4	Sustainable Production of Jatropha Biofuels in Mozambique	Science and Technology	July 2011 to July 2016	Mozambique's electrification rate was only about 12 percent in 2007, and the development of biofuels is considered important because of limited energy feedstocks and transport capacity. The country's tropical climate is also considered suitable for production of biofuel jatropha, but production and fuel technologies are lacking. Through this cooperation, JICA supports the establishment of techniques for cultivation and utilization of jatropha suitable for the arid regions of the country. By this attempt, it is expected to gain scientific evidence regarding the effects of jatropha on environmental conservation and environmental improvement.
5	Nacala Corridor Agricultural Development Research and Technology Transfer Capacity Development Project	Technical cooperation	May 2011 to November 2017	The Nacala Corridor region in northern Mozambique is a region with high potential for agricultural development. It is blessed with abundant rainfall and extensive arable land in the tropical savanna climate, but its productivity is law due to limited agricultural technology. In order to establish a model for agriculture development adapted to the region, this cooperation assists in improving the research capacity of agricultural experiment stations in the northeastern and northwestern regions, and in conducting demonstration exhibitions of new agricultural technologies at pilot farms. By this attempt, JICA expects that appropriate agricultural technology will be developed and that technology will be transferred, and eventually aims to improve agricultural productivity in this corridor region.

Source: JICA Survey Team

Table 2-45　Recent Cooperation in the Agriculture Sector

#	Project Name	Scheme	Period	Overview
6	Support for the Formulation of the Nacala Corridor Agricultural Development Master Plan	Development plan	2015-2016	This project provides support for social infrastructure development such as the development and renovation of roads and bridges in the Nacala Corridor and surrounding areas, as well as agricultural development in the surrounding areas of the corridor and comprehensive (inclusive) support in areas such as education and health.
7	Rice Cultivation Promotion and Distribution Improvement Technical Cooperation Project	Technical cooperation project	2016-2019	This project supports organizing and strengthening the current systems to disseminate technology that will be useful in improving farmers' livelihoods as well as trains promoters of these technologies. The project scope includes organization of farmers, reinforcement of their structures, and improvement in agricultural productivity by providing guidance and support for the establishment of appropriate farming methods and farming techniques. Through these attempts, the project aims to improve farmers' lives and livelihoods and helps them improve administrative ability in agriculture and rural development. JICA also provides support for increasing rice production, utilizing initiatives of CARD.
8	Tropical Savannah Agricultural Development Program (ProSAVANA- -JBM)		2011-2019	Japan has a experience in cooperating with Brazil in agricultural development (Japan-Brazil agricultural development cooperation programs in the Cerrado region of Brazil, which lasted 20 years beginning from the 1970s). Since Mozambique has similar natural conditions and is a Portuguese-speaking country as well as Brazil, Japan and Brazil have been working together for agricultural development in the tropical savannah of the Nacala Corridor in the northern part of Mozambique. The program is comprised of three pillars: (1) research and technological capacity transfer business (ProSAVANA-PI); (2) master plan development support business (ProSAVANA-PD); (3) community level development model formation business (ProSAVANA-PEM).

Source: JICA Survey Team

Several donors are providing support to the agricultural sector using ICT (as in below table). In particular, since the beginning of the 2010s, ICT-based support projects have flourished, including the provision of information using communication networks and the development of analytical platforms using information databases.

Table 2-46　Related projects by other donors in the field of agriculture

#1	Donors, etc.	Project Name	Period	Overview
1	African business council, African agriculture WG	African agriculture innovation platform initiative	2019-2028	This project (1) contributes to improving farmers' livelihoods by building and organizing infrastructure for the digitization of agriculture in Africa; supporting the establishment of platforms; visualizing agriculture and farmers. It optimizes cross-sectoral cooperation; promotes entry and investment in new areas including financial and insurance services; (2) promotes the introduction of advanced agricultural technologies; develops public-private innovation laboratories for showcasing advanced agricultural technologies; scales out and disseminates technologies to other countries
2	Alliance for a green revolution in Africa (AGRA), JICA	Coalition for African Rice Development (CARD) initiative	2008-2018 (Phase 1) 2019-Phase 2	CARD is a strategy (initiative) to support self-help efforts to expand rice production in Africa. It also works as a consultative group. It aims to work with interested rice producers to double rice production in Sub-Saharan Africa in 10 years. This target was achieved in 2018
3	International Fund for Agricultural Development	Mozambique National Agricultural Extension Program (PRONEA) Supporting projects (PSPs)	2017-	This project has provided information mainly on crop diseases and insect pests using an android application called "PlanWise". It also involves in business operations using SMEAs (Sistema de Monitoria e Extension ã o Agrá ria/agricultural extension and monitoring systems).
4	Brazil International Cooperation Agency (ABC)	Community Level Development Modeling Project (ProSAVANA-PEM)	2011-	This project (Nakala community level development model formation project: ProSAVANA-PEM) develops a database of information on activities within the project using a platform called "SIRADE (Sistema de recolha e An á lise de Dados em Extens ã o/Disseminated data collection and analysis system)."
5	NCBA CLUSA	Provision of information to farmers using exclusive lines	2010-	NCBA CLUSA, a U.S. nongovernmental organization collaborates with VODACOM to open exclusive lines (*84321# or *321#) and provides various information to farmers. VODACOM is accompany that operates telecommunications services in Mozambique.

Source: JICA Survey Team

(3)　Applicability of various digital technologies

As mentioned above, in Mozambique's agriculture, challenges exist in the value chains of production, manufacturing/processing, distribution, and marketing/consumption, and agricultural productivity and access to markets are not considered to have improved. One of the common bottlenecks in the revision of each process is the lack of effective use of information. Therefore, we have compiled information on individual case studies of digital technologies that could help small-scale farmers in Mozambique to make better use of information and contribute to improved agricultural productivity and access to markets. The names of the companies, an overview of their services, and a summary of their advantages are given below.

Example of ICT solutions (1)

Nippon Biodiesel Fuel is developing a smartphone application service for agricultural cooperatives. The company established a local subsidiary in Mozambique in 2012 and has been contributing to the improvement of productivity and agricultural management of small-scale farmers through the cultivation of biofuels and the operation of an electronic agricultural cooperative platform.

Company name	Nippon Biodiesel Fuel Co., Ltd.
Head office	Kanagawa, Japan
Establishment	2000
Number of employees	-
Investment stage	¥50 million (as of March 2019)
Deployment	Mozambique

Service overview	Using the electronic agricultural cooperative platform, match farmers with material sellers at a distance, and provide services such as time deposits and micro-credit to farmers in apps.
Advantage	✓ Collaboration with WFP ✓ Matching farmers and buyers who want to purchase agricultural products ✓ Intermediation between farmers and manufacturers of agricultural materials who want to sell fertilizers and seeds ✓ In addition to small loans, the company collects purchase history and credit information. In addition to e-money, payments are made through mobile money of three major mobile operators in the country as well as bank accounts.

Figure 2-86   Electronic agricultural cooperative platform to match farmers with buyers

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (2)

Kitovu is using ICT to connect farmers with buyers, fertilizer and pesticide advice, and to develop matching solutions between farmers and financial services in Nigeria. If the company's service is rolled out in Mozambique, it is expected to improve access to finance for small-scale farmers and improve crop production by using more suitable fertilizers and pesticides.

Company name	Kitovu
Head office	Nigeria
Establishment	2016
Number of employees	-
Investment stage	-
Deployment	Six states in Nigeria

Service overview	Collect soil and geographical data on farmland and provide advice on fertilizer and pesticides appropriate to each condition. Match farmers with buyers and financial institutions.
Advantage	✓ Farmers' yield increased by 300% ✓ The company received awards for innovation and agriculture both in the country and overseas ✓ The company been working in six Nigeria states and helping more than 10,000 farmers

Figure 2-87   Solution to connect farmers to financial services

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (3)

Aerobotics is developing a monitoring system that uses ICT to manage crop risks from the sky using satellites and drones. If the company's service is deployed in Mozambique, it could improve agricultural productivity through more efficient crop monitoring.

Company name	Aerobotics
Head office	South Africa
Establishment	2014
Number of employees	-
Investment stage	-
Deployment	Uganda and Asia (especially Laos)

Service overview	Monitoring crop health using drones and satellites. On-line data to visualize health status of all crops
Advantage	✓ Monitoring the health status of crops from above can lead to early detection of unhealthy crops ✓ Focusing on crops that need treatment enables significant savings in time and cost

Figure 2-88　Monitoring crop health using drones and satellites

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (4)

Saka no Tochu is developing a matching platform for production management and sales of value added organic agricultural products. If the company's service is rolled out in Mozambique, it could improve the productivity of agricultural operations by matching small-scale farmers with buyers and improving order placement and receipt.

Company name	Saka no Tochu
Head office	Kyoto, Japan
Establishment	2004
Number of employees	About 40 employees
Investment stage	¥851 million
Deployment	Uganda and Asia (especially Laos)

Service overview	Organic agricultural production management, matching between producers and buyers. IT system to support the provision of opportunities and the optimization of ordering
Advantage	✓ Supporting cultivation planning based on market needs, networking farmers with low-volume, unstable production, and providing production and marketing know-how to support stable supply and market development ✓ Establishment of an self-reliant agricultural model to increase the income of organic producers by cultivating markets and increasing the added value of products.

Figure 2-89　Organic agricultural production and marketing matching system

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (5)

Kobo360, a truck dispatch matching service, is developing an app that matches carriers with companies that have cargo transportation needs. If the company's service is rolled out in Mozambique, it could improve the productivity of small-scale farmers by shortening the time it takes to transport agricultural products and reducing logistics costs.

Company name	kobo360		Service overview	On-demand matching of SMEs, freight carriers, and forwarding agents with transportation needs on apps
Head office	Nigeria			
Establishment	2017			
Number of employees	-			
Investment stage	Fund raised: $1.2 million		Advantage	✓ Avoiding intermediaries between shippers and drivers reduces high distribution costs. ✓ Reduce lost opportunities resulting from returning empty after delivery
Deployment	Nigeria Planning to expand to Togo, Cote d'Ivoire, Ghana and Senegal in the future			

Figure 2-90　Platform for matching SMEs, freight carriers, and forwarding agents

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (6)

MARS Company is developing a system to add value to agricultural and marine products by introducing advanced refrigeration and storage technology, with the aim of providing refrigeration technology that contributes to harvest loss. If the company's service is rolled out in Mozambique, it could help stabilize the operations of small-scale farmers by reducing the impact of market fluctuations by preserving the freshness of crops.

Company name	MARS Company		Service overview	Development and sales of products that use unique refrigeration technology to create an environment in which fresh foods are not frozen even under freezing temperatures and to preserve freshness
Head office	Gunma, Japan			
Establishment	2006			
Number of employees	-			
Investment stage	¥99 million		Advantage	✓ Kuraban, which preserves three to ten times the freshness of conventional refrigerators without freezing ingredients ✓ Sea snow, a snow-like ice that greatly improves fish shelf life and reduces transportation costs ✓ Adopted as JICA's popularization and demonstration project in 2017
Deployment	Expanded operations to South Korea and Morocco			

Figure 2-91　Supplying refrigeration technology that contributes to reducing the harvest loss

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (7)

Twiga Foods is developing a mobile-based produce distribution platform that connects farmers and retailers at a reasonable price. If the company's service is rolled out in Mozambique, it could increase the productivity of farm businesses by optimizing crop logistics, reducing intermediate costs, and improving the marketing orientation of farmers.

Company name	Twiga Foods
Head office	Kenya
Establishment	2014
Number of employees	300 (estimated)
Investment stage	-
Deployment	Kenya

Service overview	Providing a distribution platform to connect farmers and retailers to open agricultural markets
Advantage	✓ Delivering about 3,000 outputs a day through a network of 17,000 farmers and 8,000 vendors ✓ Use M-Pesa mobile money to settle via mobile applications and to coordinate product exchanges ✓ Procurement of ¥1.1 billion from IFC of the World Bank Group, a private equity fund TLcom, GAFSP (Global Agriculture and Food Security Programme), and other organizations

Figure 2-92　Mobile-based B2B agro-distribution platform

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (8)

NEC is developing a system that uses advanced technology to acquire various data and provide optimal farming advice in virtual fields. If the company's service is deployed in Mozambique, it has the potential to improve the productivity of farming operations by increasing yields through appropriate farming advice and prediction of yields and optimal harvesting times.

Company name	NEC Corporation
Head Office	Tokyo, Japan
Establishment	1899
Number of Employees	20,252 employees (unconsolidated)
Investment stage	¥397.2 billion (as of March 31, 2019)
Deployment	It has a wide range of operations in EMEA, Greater China, APAC, North America, and Latin America and also has local subsidiaries.

Service overview	Optimization of water, fertilizer, agricultural chemicals, etc. and maximization of yields in accordance with crop growth conditions and weather conditions
Advantage	➢ Based on data obtained from weather and soil sensors, satellites, drones, etc., and data obtained from farming environments such as irrigation and fertilization, a virtual farm is generated on a computer. Based on a simulation of growth on the virtual farm, an optimum farming advice and a forecast of yield and harvest timing are made according to the land.

Figure 2-93　Improving crop yields and cultivation efficiency

Source: JICA Survey Team based on the website of the company concerned

(4)   Potential OI themes

As for the agricultural sector, after discussions with JICA's Mozambique office, it was confirmed that OI themes related to solutions for collecting and sharing agricultural commodity prices and solutions for technology dissemination to dispersed farmers would be considered, with a view to possible collaboration with the agricultural project that the office plans to implement in FY2020-2021.

2.6.4   Improving efficiency of payments for public services

(1)   Current situation and issues of public services

The Mozambican government organization INAS (Instituto Nacional de Acção Social; National Institution of Social Action) provides minimum livelihood security benefits to about 310,000 people every year under its Government to Person Payment program. INAS (Instituto Nacional de Acção Social; National Institution of Social Action), a governmental organization, provides minimum livelihood security benefits to about 310,000 people every year under the Government to Person Payment program. Currently, cash is delivered at about 6,200 payment points nationwide, but since the logistic cost is as high as 15%, the government considers efficiency improvement to be an urgent issue and is considering computerizing the program. The current status of ICT use in Mozambique for improving the efficiency of public service payments is as follows.

➢ As of 2016, the percentage of adults holding e-money accounts in Mozambique was about 40 percent.

➢ As of 2014, mobile money was notably used for airtime purchases and as a means of paying utility bills, followed by the use of services similar to banking services, such as sending and receiving money, withdrawing money (cashing in the amount received), and cash deposits.

Following ICT-related policies have been implemented by the government of Mozambique in the area of public service.

Table 2-47   Government Initiatives

#	Policy document	Details
1	Strategic Policies for the Implementation of ICT (Política para a Sociedade da Informa çã)	In 2002, the "ICT Implementation Strategic Policy" was formulated with the aim of improving the living infrastructure in Mozambique. This ICT policy was positioned as an important means to support the implementation of the absolute poverty reduction action plan. The plan covers six main areas: (1) education; (2) talent development; (3) insurance; (4) universal access; (5) infrastructure; and (6) governance. 37 action plans were implemented.
2	Strategies for Scientific and Technological Innovations (Estratégia de Ci ê ncia, Tecnologia e Inova çã o Mo ç Ambique (ECTIM)) (2006-2016)	The strategy for science and technology innovation (ECTIM) is a follow-up to the IT Policy, which was approved as a new strategy in 2006. It was designed to establish strategic objectives and programs to promote the development of science, technology and innovation.

Source: JICA Survey Team

On the other hand, electronic money is spreading rapidly in Mozambique.

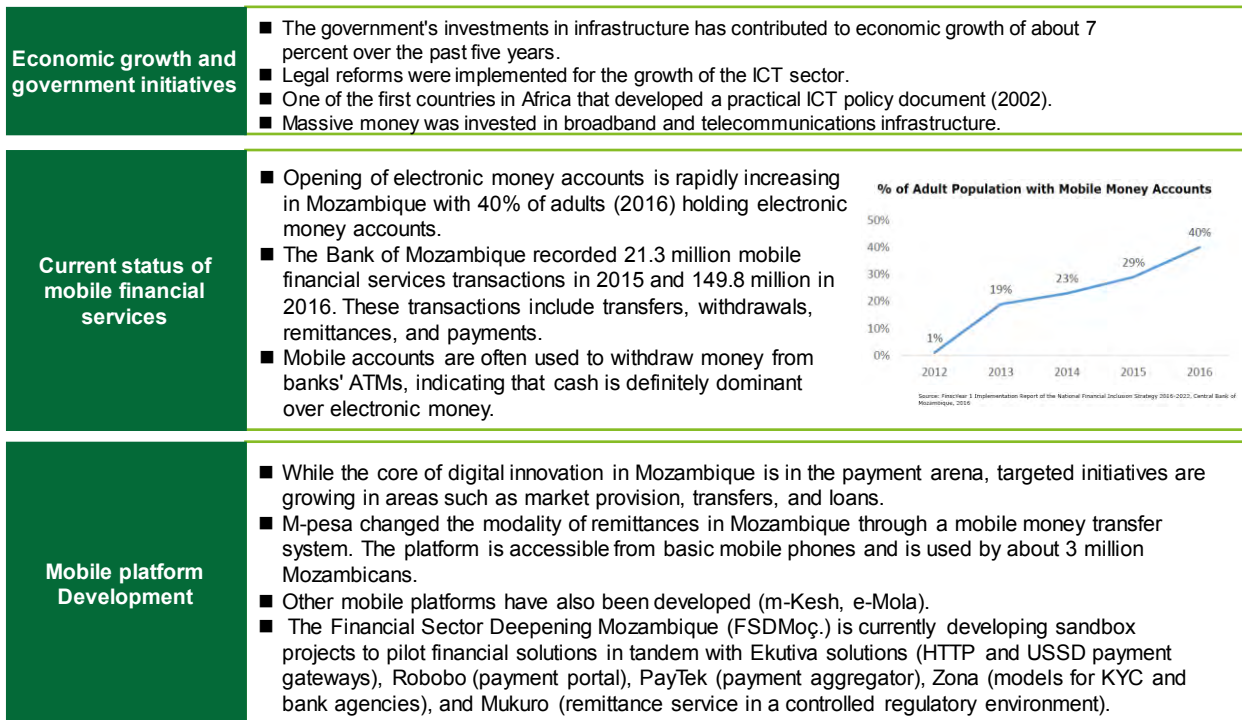| Economic growth and government initiatives	- The government's investments in infrastructure has contributed to economic growth of about 7 percent over the past five years. - Legal reforms were implemented for the growth of the ICT sector. - One of the first countries in Africa that developed a practical ICT policy document (2002). - Massive money was invested in broadband and telecommunications infrastructure.
Current status of mobile financial services	- Opening of electronic money accounts is rapidly increasing in Mozambique with 40% of adults (2016) holding electronic money accounts. - The Bank of Mozambique recorded 21.3 million mobile financial services transactions in 2015 and 149.8 million in 2016. These transactions include transfers, withdrawals, remittances, and payments. - Mobile accounts are often used to withdraw money from banks' ATMs, indicating that cash is definitely dominant over electronic money. **% of Adult Population with Mobile Money Accounts** — 2012: 1%, 2013: 19%, 2014: 23%, 2015: 29%, 2016: 40% Source: FinScfest 1 Implementation Report of the National Financial Inclusion Strategy 2016-2022, Central Bank of Mozambique, 2016
Mobile platform Development	- While the core of digital innovation in Mozambique is in the payment arena, targeted initiatives are growing in areas such as market provision, transfers, and loans. - M-pesa changed the modality of remittances in Mozambique through a mobile money transfer system. The platform is accessible from basic mobile phones and is used by about 3 million Mozambicans. - Other mobile platforms have also been developed (m-Kesh, e-Mola). - The Financial Sector Deepening Mozambique (FSDMoç.) is currently developing sandbox projects to pilot financial solutions in tandem with Ekutiva solutions (HTTP and USSD payment gateways), Robobo (payment portal), PayTek (payment aggregator), Zona (models for KYC and bank agencies), and Mukuro (remittance service in a controlled regulatory environment).

Figure 2-94   Current status of payments for public services in Mozambique

Source: JICA Survey Team

Issues in the ICT sector related to public service payments include insufficient infrastructure, inadequate ICT services, and lagging development environment.
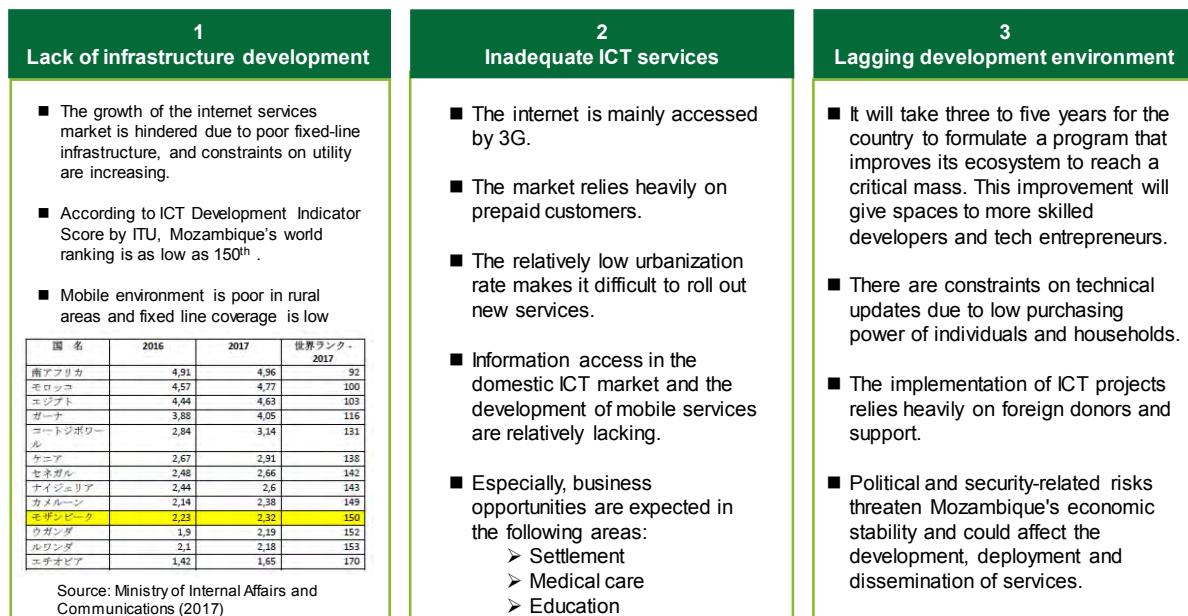
1 Lack of infrastructure development	2 Inadequate ICT services	3 Lagging development environment
- The growth of the internet services market is hindered due to poor fixed-line infrastructure, and constraints on utility are increasing. - According to ICT Development Indicator Score by ITU, Mozambique's world ranking is as low as 150th. - Mobile environment is poor in rural areas and fixed line coverage is low	- The internet is mainly accessed by 3G. - The market relies heavily on prepaid customers. - The relatively low urbanization rate makes it difficult to roll out new services. - Information access in the domestic ICT market and the development of mobile services are relatively lacking. - Especially, business opportunities are expected in the following areas: ➢ Settlement ➢ Medical care ➢ Education	- It will take three to five years for the country to formulate a program that improves its ecosystem to reach a critical mass. This improvement will give spaces to more skilled developers and tech entrepreneurs. - There are constraints on technical updates due to low purchasing power of individuals and households. - The implementation of ICT projects relies heavily on foreign donors and support. - Political and security-related risks threaten Mozambique's economic stability and could affect the development, deployment and dissemination of services.

Table in column 1:

国　名	2016	2017	世界ランク・2017
南アフリカ	4,91	4,96	92
モロッコ	4,57	4,77	100
エジプト	4,44	4,63	103
ガーナ	3,88	4,05	116
コートジボワール	2,84	3,14	131
ケニア	2,67	2,91	138
セネガル	2,48	2,66	142
ナイジェリア	2,44	2,6	143
カメルーン	2,14	2,38	149
モザンビーク	2,23	2,32	150
ウガンダ	1,9	2,19	152
ルワンダ	2,1	2,18	153
エチオピア	1,42	1,65	170

Source: Ministry of Internal Affairs and Communications (2017)

Figure 2-95   Challenges related to Tanzania's public service payments

Source: JICA Survey Team

(2) Recent cooperation by JICA and other donors

Cooperation achievements related to public service payments are limited.

Table 2-48   Recent Cooperation in Payments for Public Services

#	Project Name	Scheme	Period	C/P	Overview
1	Dissemination of VAT Collection and Management Systems	Private-sector partnership project	2017	Joint entity between BMC International Corporation and Kaihatsu Management Consulting Inc.	This is a technical cooperation project and was implemented with the following objectives: ・Increasing VAT collection by implementing BMC's products ・Maximizing the effects of introduction by designing systems, formulating introduction plans, and supporting operation management ・Increasing tax revenue through effective operation of the system, expansion of the tax collection base, improvement of business management ability, and job creation ・Eliminating dependence on aids by increasing tax revenue; securing budget for economic and social development; reducing poverty

Source: JICA Survey Team

Several donors have provided support for ICT-based public service payment (as shown in below table).

Table 2-49   Related projects utilizing ICT by other donors in payment of public services

#1	Donors, etc.	Project Name	Period	Overview
1	Italy, the World Bank	E-government network (GovNET)	2004-	This project was launched in 2004 with the support from the government of Italy and the World Bank to provide support for the development of e-government networks, including technical (hardware, software, network) requirements, appropriate communication protocols, naming rules, and security rules. After implementation in the central government, connection has been expanded to 128 regions in Mozambique
2	UNDP, the Italian government, Microsoft and the Finnish government	State Digital Resource Center (CPRD)	2004-	This program concentrates ICT infrastructure, skills and investments; promotes local demand for and use of ICT by all sectors involving development; supports the development of local content by providing single entry points for ICT development and activities in rural areas
3	Swedish National Tax Agency	National registration system (SINAREC)	-	This project aims for efficient and effective planning and implementation of social services for citizens; promotion of democracy through efficient use of accurately registered citizen data for the voting system; promotion of efficient, effective and fair government
4	World Bank, UNESCO and UNDP	Multimedia community center (MCC) program	-	This program aims to enable communities to provide a means to access information through a single point, using a wide range of information and communication technologies. It will also help reduce digital disparities and poverty.
5	UNDP and the Italian government	Mobile ICT unit	-	This project provides remote training courses from ICT facilities to address tasks of fostering ICT skilled talent across the country. These training courses provide programmes related to civil servants and other community members.
6	World Bank	Mozambique e-Government Infrastructure Project (MEGCIP)	2010-2014	This project aimes at reducing communication costs by expanding the geographic reach of broadband networks and promoting efficiency and transparency through e-government applications. It is led by the Ministry of Science and Technology and consists of components focused on communications infrastructure, policies and regulations, e-government applications, and organizational capacity building.

Source: JICA Survey Team

(3) Applicability of various digital technologies

As mentioned above, the challenges in the ICT sector related to public service payment in Mozambique include lack of infrastructure development, stagnant ICT services, and lagging development environment. Although it is expected that solving these issues will require a lot of money and time to improve the infrastructure and development environment, the introduction of services and technologies already used in other countries is expected to increase usage and improve the infrastructure and development environment by making people aware of their convenience. Therefore, we have compiled information on individual case studies of digital technologies that are expected to contribute to the development and increased use of the relevant infrastructure for public payments in Mozambique. The names of the companies, an overview of their services, and a summary of their advantages are given below.

Example of ICT solutions (1)

NEC Technologies India is developing a common service center for the purpose of upgrading administrative services in rural areas with usnig IT. If introduced in Mozambique, the use of IT for payment of subsidies, etc. and the use of electronic money can be expected to expand.

Company name	NEC Technologies India (NECTI)
Head Office	New Delhi, India
Establishment	2006
Number of Employees	-
Investment stage	-
Country of operation	India (NEC Technologies India, NEC's entity incorporated in India, invests in CSC e-Governance Services India Ltd. [CSC])

Service overview	The Indian government has set up common service centers in approximately 300,000 locations in India to upgrade administrative services in rural areas using IT. More than 300 types of services are provided, including public services such as issuing administrative documents and granting subsidies, and private services such as mobile phone contracts and the sale of insurance products.
Superiorities	✓ This company can analyze huge transaction data in collaboration with CSC ✓ It performs joint development of new digital services in fields such as finance, education and healthcare

Figure 2-96　Creating and providing public services such as granting subsidies

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (2)

BMC International is developing a system to collect value-added tax (VAT) from stores, aiming to improve the efficiency of tax collection. In Mozambique, where the rollout has actually started, the efficiency of VAT collection in stores has been improved.

Company name	BMC International Inc.
Head Office	Nairobi, Kenya
Establishment	1976
Number of Employees	10 people
Investment stage	-
Countries of operation	Operating in Kenya, Ethiopia, and Mozambique in Africa

Service overview	This company installs BMC system terminal equipment (a register called "Fiscal Machine" equipped with a special arrangement for collecting VAT) at stores. It aims to increase tax revenue through effective operation of the scheme, expand tax collection base, improve business management ability, and create employment
Superiorities	✓ Providing latest VAT collection and management system with superior safety and convenience ✓ Introducing support services based on experiences in more than 20 countries ✓ Providing total package support services including server operation services not only the delivery of equipment

Figure 2-97　Establishing a system to collect value-added tax (VAT) from stores for more efficient tax collection

Source: JICA Survey Team based on the website of the company concerned

Example of ICT solutions (3)

Vodacom Moçambique is developing M-Pesa, which provides financial services such as money transfer and microfinance using cell phones. The service has also been launched in Mozambique, contributing to the expansion of financial inclusion by providing services such as electronic remittances and deposits.

Mechanism of M-Pesa in Kenya

Company name	Vodacom Moçambique
Head Office	Maputo, Mozambique
Establishment	2003
Number of Employees	-
Investment stage	-
Country of operation	Operating in Mozambique

Service overview	This company provides services of contactless payments, money transfers, and microfinance using mobile phones. By sending SMS messages from a customers' mobile phone, the customer can engage in financial transactions such as remittance, deposit/withdrawal, and payment, and receive the same service anywhere in the country.
Superiorities	✓ The company's services are simple, fast, affordable, and safe ✓ No need to have credit cards, bank accounts, and internet environment

Figure 2-98   Improving the efficiency of financial transactions using mobile phone

Source: JICA Survey Team based on the website of the company concerned

⑷ Potential OI themes

Based on discussions with JICA Mozambique Office, the team has decided to drop the topic as other themes such as education and agriculture has wider options compared to improving efficiency of payments for public services.

Chapter 3 Implementation of Open Innovation (Private Companies)

3.1   The outline of Implementation of Open Innovation

3.1.1   The metod of Implementation for Open Innovation

(1)   Overview of Project Formation from Theme Setting

The survey aims to identify issues and solutions, and ultimately project formation through open innovation. While project formation to be ODA projects (B to G) is primary expectation, to be private sector projects (B to B) are also targeted. The following Figure shows an overview of the project formation process from the setting of theme.
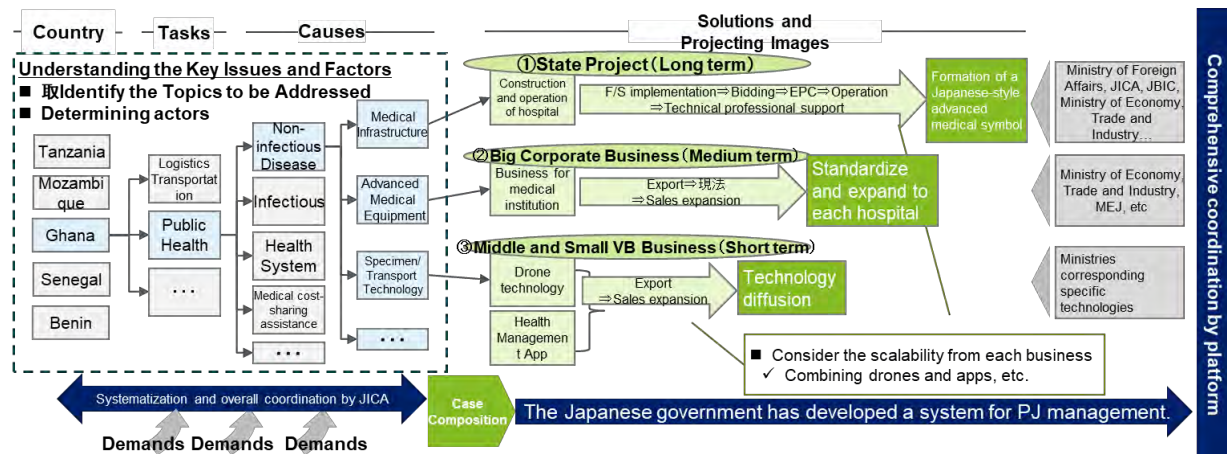
Figure 3-1   Overview of Project Formation from Theme Setting

Source: JICA Survey Team

(2)   Open Innovation

By incorporating skills and ideas of various actors (such as, private companies, governments, business organizations and academic inttitutions) into open innovation, it allows to figure out the solutions for development issues in Africa. Collaborating with external organizations from early phase (i.e, a phase of the setting of the theme) enables to the co-operation and involvement of external organizations in promotion of open innovation. It should be noted that, in advance of commencing open innovation, it is necessary to clarify and set the design of incentives for the stakeholders.
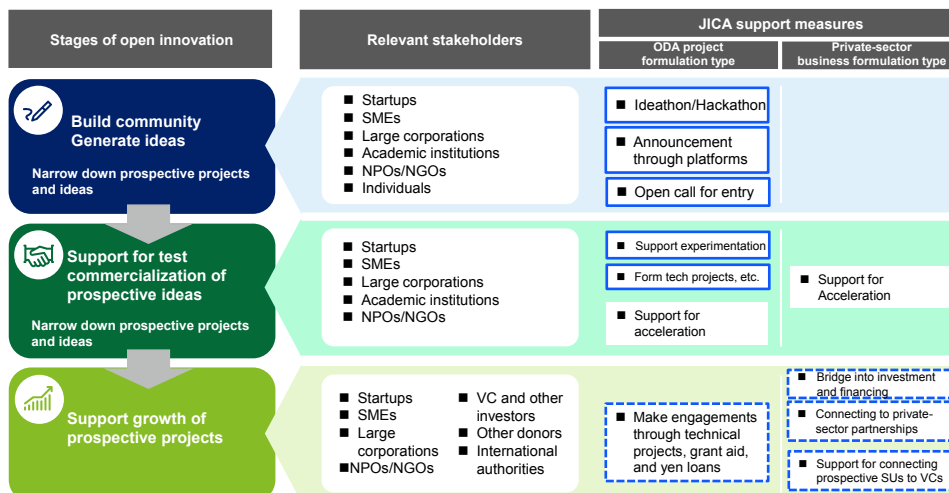
Figure 3-2   Stakeholders of Open Innovation in each stage

Source: JICA Survey Team

> **Building Partnerships in Solving Issues**

The survey attemps to identify solutions to development issues through open innovation with the multiple actors (such as, startups, corporations, college,investors and local government officials and local experts) that are interested in solving social issues in developing countries. Interviews were conducted with these stakeholders to confirm the possibilities for collaboration in open innovation.

In order to obtain the cooperation and involvement of external organizations from the stage of setting theme, it was confirmed the areas of interest of large companies and academic institutions in each country, as well as the possibility of collaboration in forming solutions

> **Collaboration for Commercialization**

In this survey, the formation of ODA projects is the main goal. However, in case that a private sector project (B to B) is considered more suitable in the process of open innovation, it is necessary to establish connections to VCs, investor and financers.

In the medium to long term, STI for TICAD Open Innovation Platform will collaborate with large corporations, foundations, private funds, accelerators, etc. that supports the ideas of the said Platform. In other words, to establish a supporting system of the commercialization of ideas with sponsors and cooperating organizations is important.

(3) Problem-Solving-Oriented Theme Setting

> **How to Identify Issues (Information on Needs)**

In the formation of new businesses through open innovation, discussions should start with the question, "What are the issues that need to be resolved?" rather than the introduction of STI, so that the introduction of technology is not the only objective.

Furthermore, when introducing STI, it is essential to consider various factors such as the local policy/regulatory environment, the local socio-cultural environment, the status of infrastructure such as communication networks and electricity to provide services, the diffusion of devices such as smartphones to provide services, the availability of data, and strategies for human resource development. It is necessary to consider a variety of factors. As Professor Richard Heeks of the University of Manchester has shown in his Onion Ring Model (Figure below), various factors such as Environment, Organization, Information System, Technology, and Information need to be considered for the successful implementation of STI. As Professor Richard Heeks of the University of Manchester shows in his onion ring model (Figure below), it is important to consider various factors such as environment, organization, information system, technology, and information in order to successfully implement STI.
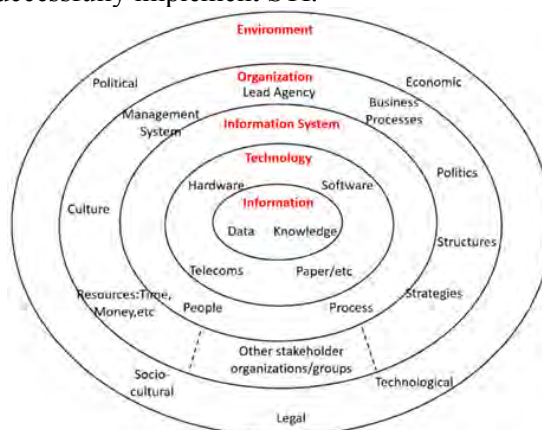

Figure 3-3   Onion-ring Model

Source: Heeks (2018)[3]

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[3] Richard Heeks (2018). Information Communication Technology for Development

The flow of the theme setting is shown in Figure below. Information on needs is gathered and analyzed from existing reports and databases. Not only organizing the case studies, but also new business hypotheses and points that should be varified are orgaized.

1	Review JICA's past work on the topics related to each country's issues and the assets JICA can provide to solution providers. ➢ Collect and analyze data from on-site surveys, JICA professionals, JOCV, etc., and identify issues for business opportunities.
2	Analyze and organize issues based on JICA's relevant reports, etc.
3	Investigate trends related to other donors' STIs.
4	Organize the existing STI application cases in the target field of each country, and summarize them, if any.
5	Collect information on innovation trends and stakeholders in emerging countries, developing countries, target countries, and Japan related to the subject areas. ➢ With regards to trends in innovation and technologies, we will strive to conduct efficient research using Tech Harbor, Deloitte Tohmatsu Group's proprietary platform for searching for information on startups and technologies around the world.

Figure 3-4   Flow of Theme Setting

Source: JICA Survey Team

(4)   Scope of PoC

Organization of the PoC projects to be Covered by This Survey

The scope of PoC in this survey is to cover several projects in the target sectors in the new target countries. In addition, the survey team have coordinated with JICA on whether to include the KOSEN PoC projects in the 1st phase of the survey and the agricultural PoC projects that JICA has been planning for some time in this survey.

	JICA agricultural PoC		**Kosen PoC in 1st Survey**	**PoC that could be implemented in this survey**	
Target area	■ Kenya ■ Ghana ■ Uganda	*Prospective countries at present, not yet confirmed	■ Kenya ■ Rwanda ■ Nigeria	■ Senegal ■ Ghana ■ Benin	■ Tanzania ■ Mozambique
Previous overview	✓ During the 1st Survey, three PoCs were planned to be adopted in the FY2019 budget, of which an additional budget for the selected technologies was planned for FY2020, but it has not yet been implemented. ✓ JICA plan to hold a study tour in May 2020 and solicit/select ideas for PoC.		✓ Application of technical expertise is planned for Kenya (agriculture), Rwanda (agriculture), and Nigeria (utilities). ✓ However, since there are differences in the implementation success among the target countries, there is a possibility that there will be some projects in the target countries with limited progress.	✓ At present, the possibility of PoC implementation by Senegal (health), Ghana (health), Benin (e-government), Mozambique (agriculture), and Tanzania (undecided) will be examined through domestic and field surveys. ✓ As the PoCs, which were planned to be implemented in the FY2019 budget, has yet to be implemented, coordination with agricultural PoC / Kosen PoC is required in this survey.	

Figure 3-5   Target of PoC

Source: JICA Survey Team

Concept of Target Companies for PoC

Although the target companies for the PoC in this survey were initially envisioned to be Japanese companies, it was decided to select not on Japanese companies that have an advantage by the screening process, after discussing with JICA whether or not third-country companies should also be targeted

(5)   PoC Implementation Flow

Since the implementation process of the PoC differs depending on types of the PoC (i.e. agricultural PoC, KOSEN PoC, and PoC in new target country), it is being conducted by confirming with the parties concerned, including the adjustment of the schedule (see the flow figure below).
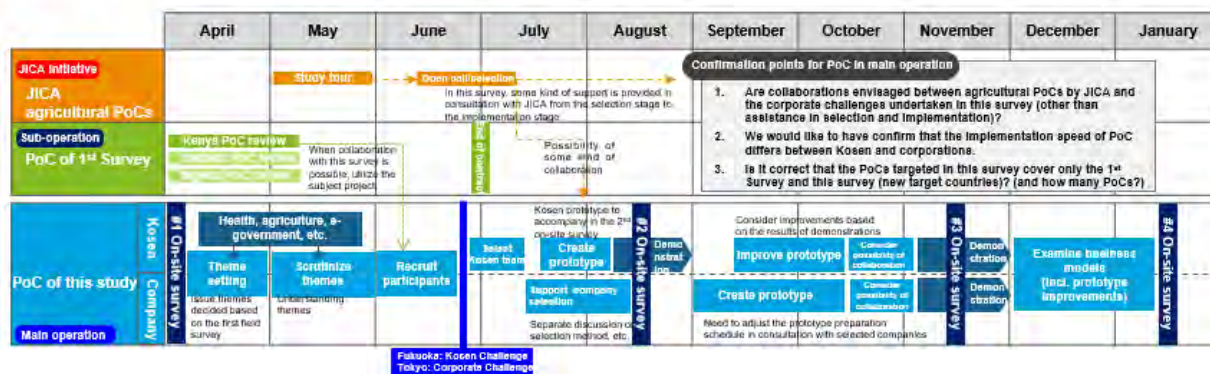
Figure 3-6　PoC Implementation Flow

Source; JICA Survey Team

3.1.2　Implementation process of Open Innovation

Milestones, roles of related parties, schedule, outputs, etc. in the process of implementing open innovation have been set and are being implemented as shown in the table below.

		~Mid Aug 2020	Sep~Oct 2020	Nov~Early Dec 2020	Mid Dec~Mar 2021	Apr~Oct 2021	Oct~Nov 2021	Dec 2021
		Decide OI Theme	Call for Proposal/ 1st Screening	PoC Detail Planning	Final Screening	PoC Implementation	Reporting the Result of PoC	Considering Next Action
Project Task		■ Decide OI theme	■ Call for proposals ■ Select applicants passing the 1st screening	■ Polishing up PoC plan	■ Hold the final screening session on online ■ Determine PoC implementors	■ Implement PoC	■ Examine the PoC result ■ Hold the reporting session	■ Consider the next action
Role	JICA	■ Make decision on OI theme ■ Establish an internal screening scheme	■ Disseminate the call for proposals by JICA's email newsletter ■ Conduct the 1st screening	■ Interview candidate applicants passing the 1st screening	■ Conduct the final screening	■ Coordinate between PoC implementor and related JICA project stakeholders	■ Review the result ■ Participate in the reporting session	■ Confirm the next action
	Survey Team	■ Prepare OI theme proposal and material ■ Prepare screening criteria ■ Prepare website for call for proposals	■ Disseminate the call for proposals by email newsletter, SNS, partner organizations, and individuals ■ Compile applications for the 1st screening	■ Arrange interview ■ Support PoC detail planning and pitch ■ Plan the final screening session	■ Hold and facilitate the final screening session ■ Conduct the final screening ■ Contract with PoC implementor	■ Support PoC implementation	■ Examine the PoC result ■ Hold the reporting session	■ Support to consider and conduct the next action
Output		■ Website ■ Screening criteria ■ Screening system	■ Document for the 1st screening ■ Result of the 1st screening	■ Materials for pitch	■ Company list selected for PoC implementation	■ PoC plan	■ Report of PoC result	■ Next action plan

Figure 3-7　Implementation Process of Open Innovation

Source: JICA Survey Team

The details of the process from the request for proposal to the selection of PoC implementers are shown in Figure below. The screening process consists of three stages: initial screening (document review), online interview, and final selection.

After the initial screening based on the application documents, an online interview was held between JICA officials and the applicant companies. The purpose of the online interview was to deepen the understanding of the solution for the JICA officials, and the on-site needs and conditions for the applicant companies, so that they could brush up on their solutions and demonstration plans for the final screening. For the final screening, it was held online, with a 10-minute pitch from the applicants followed by a 10-minute Q&A session.
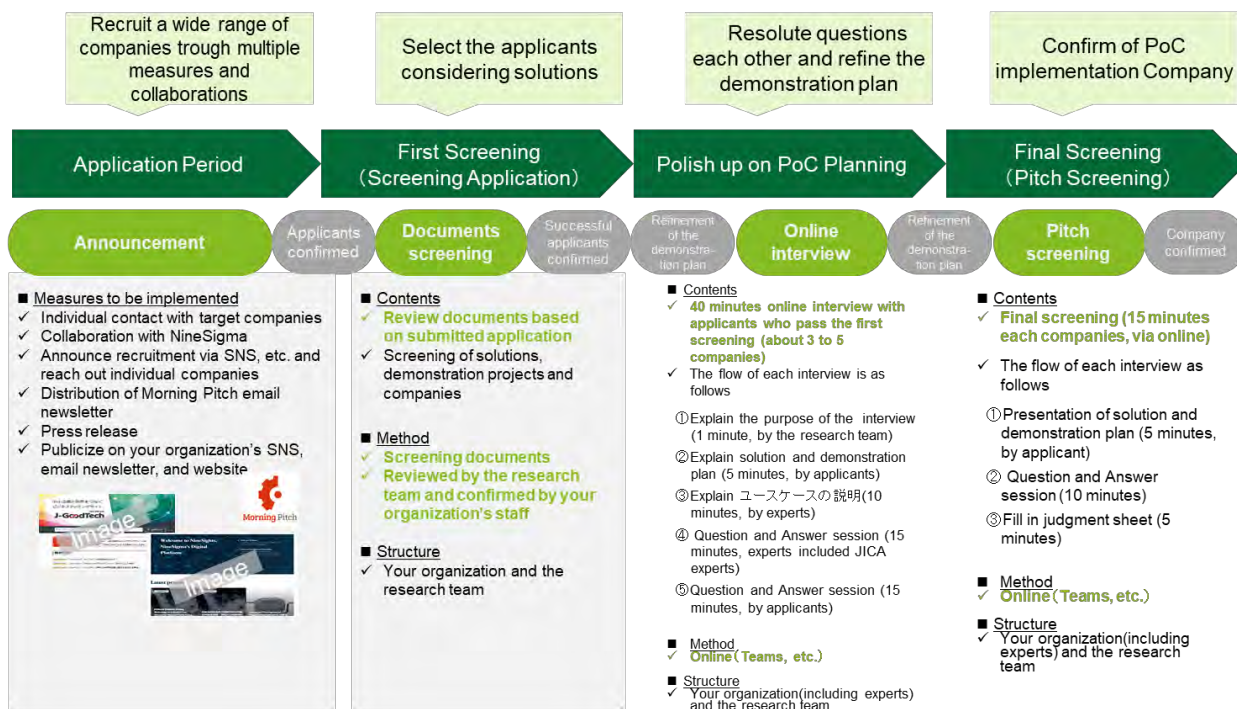
Figure 3-8　Process of Selection Companies for PoC

Source: JICA Survey Team

The screening criteria are as shown in Table below. The screening criteria included not only the technical aspects, but also included the aspects that the project could be commercialized in the end. Broadly speaking, the review was conducted from five perspectives (problem solvability, feasibility, competitive advantage, appropriateness of the PoC plan, and performance).

Figure 3-9　Selection Criteria

Source: JICA Survey Team

3.1.3 Design of Incentives for Participation

Based on the lessons learned from the first survey, it is very important to design incentives to encourage companies to participate in the implementation of open innovation. Therefore, the PoC implementation in this survey would provided PoC budget of 3 to 5 million yen, in addition to the incentives such as the possibility of business development in cooperation with JICA projects in the future and the connection with the target country's government that can be obtained by cooperating with JICA. In setting the amount, several similar initiatives were referred such as Project NINJA, which is separately implemented by JICA (30,000USD is provided to outstanding companies and organizations), and initiatives implemented by other donors (see table below). Although conditions vary between Japanese and local companies (for example, the necessity of ravel expenses), the amount is set uniformly from the perspective of fairness.

Table 3-1   Example of Call for Solutions by Other Donors

Program Name	Implementing Agency	Prize	Overview (from the Application Guidelines)
Intelligent Forecasting Competition to Model Future Contraceptive Use	USAID	25,000USD, 20,000USD	It aims to identify and test more accurate ways to predict future contraceptive use in health care delivery settings. USAID will award a $25,000 prize to an innovator who can develop a predictive model that uses USAID data and artificial intelligence to forecast contraceptive consumption over a three-month period. USAID will also provide a field implementation grant of up to $200,000 to customize and test a high-performance intelligent forecasting model in Cote d'Ivoire.
Mission Billion Challenge WURI West Africa Prize (WURI: West Africa Unique identification for Regional Integration and Inclusion)	World Bank	150,000USD (In Total)	It aims to create a digital financial service that facilitates the collection of taxes from informal sector workers. For example, the following services are envisioned; • Incorporate behavioral tools to continue payments to social insurance schemes from informal sector workers, encourage financial savings, and promote transparency and accountability • Payments can be made regardless of literacy or numeracy levels, even in the context of limited Internet penetration • A digital identity system that serves as a foundation for regional interoperability and is accessible across borders, network providers, and languages, regardless of where one is from or where one is currently located Winners of the Mission Billion Challenge will receive cash prizes totaling up to $150,000, participate in a high-level event at the World Bank, and receive mentorship and support from Google Developers Experts.
UNICEF Funding Opportunity for Blockchain Startups	UNICEF(UNICEF Innovation Fund)	Up to 100,000USD	The UNICEF Innovation Fund is seeking equity-free investments of up to $100,000 to provide early-stage seed funding and mentoring to for-profit technology startups that have the potential to benefit humanity. We aim to fund the following solutions. • People can use cryptocurrencies for income generation, savings, and access to decentralized financial products • Increased transparency in supply chains, contract management, data tracking, etc. using the blockchain. • New decision-making methods using blockchain to determine project funding.
Africa Online Safety Fund	Google.org	10,000USD, 100,000USD	The Africa Online Safety Fund will support innovative existing and new solutions to address the online safety of women and children through two categories of funding. • Catalytic projects are $10,000 grants for small, targeted, local and culture-specific interventions. • Transformative projects are $100,000 grants for large-scale interventions that reach multiple regions
Labeled Datasets for Agriculture in Sub-Saharan Africa	Lacuna Fund (Collaborative Fund by Rockefeller Foundation, Google.org, and IDRC)	500,000USD	It is looking for data scientists who can reference Earth Observation (EO) data and label agricultural datasets related to crops and other aspects of animal agriculture systems for machine learning in Sub-Saharan Africa. Grants of up to $500,000 are available for datasets that address unique challenges (e.g. mapping smallholder farmers in Africa with open source, high quality data that can be used to build real-world applications).

Source: Information of each websites reserched by JICA Survey Team

3.2   Ghana and Zambia

3.2.1   Theme Setting

⑴   Field Survey (February to March, 2020)

In Ghana, three candidate themes for OI events were initially listed: improving efficiency in traffic demand management and planning, improving health systems efficiency (maternal and child health), and electrification of un-electrified areas. In promoting the open innovation program, it is important to consider whether there are stakeholders who are familiar with local issues around the theme, whether a certain number of domestic and foreign stakeholders (mainly private companies) who can provide solutions exist, whether there is a certain degree of diversity in the solutions, and whether it is possible to secure a

demonstration site for PoC. Taking these points into consideration, through discussion, it was decided to conduct the field survey in the direction of setting a theme in the health care sector.

In the field survey, STI needs hearing was conducted to stakeholders such as "Maternal and Child Continuum of Care Improvement Project throught Maternal and Child Health Handbook", Ghana Health Service, Grameen Foundation and Savanna Signatures which provide services for pregnant women using mobile phones, donors, medical institutions, etc.

1) Maternal and Child Continuum of Care Improvement Project throught Maternal and Child Health Handbook

The following STI needs were raised from the project experts.

- ➢ Services to deliver necessary information to pregnant women and mothers

- ➢ Services for connecting to timely ANC and PNC consultations

- ➢ Follow-up support in the community after consultation at referral hospital, especially in areas where there are few specialists (early childhood development, etc.)

- ➢ Diagnostic assistance for healthcare professionals

- ➢ Sharing of image (ultrasound, X-ray, etc.) information between medical facilities

In particular, as the maternal and child health handbook supported by the project is in English, and some mothers have not received the necessary information due to language barrier, the need to deliver the necessary information in multiple languages or by voice was raised. Meanwhile, it was confimed that the Grameen Foundation conducted the "Mobile Technology to Strengthen Maternal, Newborn, and Child Health (MOTECH)" project from 2009 to 2015 in Upper East, Greater Accra, Volta and Central regions, where it provided timely information once a week to pregnant women and mothers with children up to 1 year old in seven local languages. The service also provided timely alerts (reminder) to enhance timely consultations and the timely alerts were provided even for health professionals such as CHN. Also, it was confirmed that a similar service was provided by a Ghanaian NGO called Savanna Signatures in the "Technology for Maternal and Child Health (T4MCH)" project (2011-April 2020) in Northern, Savanna, North East, Upper West, regionsVolata and Oti provinces. However, since these projects had budgetary sustainability issues, OI theme on building a sustainable business model involving private companies was raised as an option.

2）Grameen Foundation、Savanna Signatures

According to the Grameen Foundation, MOTECH has succeeded in nationwide roll-out as a government initiative in India, and in Nigeria, paid service towards mid and high income groups in urban areas are being provided in partnership with Airtel to solve the problems of operating costs. Also, in Sierra Leone, DRC, and Uganda, they provide timely messages in the local language to combat Ebola, and in Rwanda, they send messages for vaccine campaigns.

The Grameen Foundation and Savanna Signatures explained that as the effectiveness of the service regarding the provision of voice information to pregnant women using mobile phones is confirmed, it is of utmost importance to build a business model that ensures the sustainability of activities.

3) Ghana Health Service (GHS)

Discussions were held with GHS Director General and eHealth Implementation Specialist from the Policy Planning Monitoring and Evaluation Division on OI theme candidates.

According to the discussion, it was mentioned that MOTECH spent more than $3M in close cooperation with GHS's Family Health Division but could not scale up due to problems with telephone charges and

operating costs. It was explained that the project could not scale up as much to collect sufficient evidence of its effectiveness and that there was little evidence on its effect. In such regard, a negative reaction to pursuing the MOTECH approach was shown. Regarding the necessity of introducing STI, it was explained that the following areas have high priority.

➢ Solutions for improving data input to E-tracker and DHIMS, and improving analysis and utilization of its data

➢ A solution to enhance communication between Community Health Officer (CHO) or Community Health Nurse (CHN) and Community Health Volunteer (CHV)

➢ A solution that enables remote training for healthcare professionals

➢ Hospital electronic medical record system

4) Donor (World Bank, USAID)

The World Bank is supporting the development and implementation of NHIS's insurance claim management system but has no other STI implementation cases or future plans in the health sector.

On the other hand, USAID is implementing many initiatives as follows.

➢ Supporting E-tracker training in 3 regions in collaboration with Good Neighbors

➢ Introducing telemedicine systems to remote locations in the "Developing Acute Care and Emergency Referral Systems Project in Ghana (ACERS)"

➢ Supporting the digitization of Supportive Supervision, such as connecting the results of Supportive Supervision to DHIMS

➢ Supporting the development and introduction of community scorecards, which are web dashboards

➢ Supporting the introduction of the Ghana Integrated Logistics Management System (GILMS), which supports inventory management of pharmaceuticals and materials and can also forecast demand using AI.

➢ Supporting the development and introduction of NHIS billing management dashboard

Among them, regarding E-tracker, there are major issues in data entry, analysis and utilization, and it has not been possible to scale up to other regions. As filling out the designated forms and inputting to E-tracker are double work for health workers, the motivation for healthworkers to input data is low. Also, challenges such as many application defects, low data reliability, and the activities of many NGOs and donors being carried out separately and not integrated were raised.

5) Health facilities

South Tongu DHD (District Health Director), Dabal Health Center and Sogakope North CHPS in Volta, Sogakope were visited to survey the challenges on data input and utilization, which GHS and USAID raised as issues with particularly high STI needs. The contents of the hearing are as described below.

In each medical facility (health center, CHPS), there is a paper format called Register for each service provided by each facility, and CHO and CHN handwrite information for each patient in a standard format for each service. ing. The information is reflected in E-Tracker and DHIMS in the following form.

Table 3-2   Data input into E-Trackerand DHIMS

	E-Tracker	DHIMS
Input frequency	Update every time a patient arrives	Once a month
Method of input	Information is entered into a dedicatedapplication on the provided tablet based on the handwritten information	After collecting information in a standard paper format for DHIMS (for each service) at each facility, a hard copy is sent to the DHD, then the data is entered in DHD

Source : JICA Survey Team

➢ South Tongu DHD(District Health Director)

- DHD Information officer is responsible for system data at 4 Health centers and 21 CHPS in the region.

- Monthly DHIMS reports will be submitted to the Region, and important indicators (malaria, vaccination rates, etc.) will be notified as performance reviews for each facility.

- Challenge:Each facility receives many questions about E-Tracker, especially small system-related complaints such as tablet failures and application malfunctions, and there is only one person in charge (Information Officer) to handle them. Being busy with the response, bad communication environment, etc.

➢ Dabal Health Center

- The largest health center in the region with 15 employees (CHN, midwives, etc.)

- Challenge: Since there are only two tablets, the number of tablets cannot keep up with the number of patients in order to input in real time, and in many cases, multiple handwritten Registers are required to examine 500 children a month. As a result, it takes time to find out which child is listed in which part, and there are deficiencies such as duplicate descriptions. When the communication environment is bad you may not be able to log in to the E-tracker app for about a month.

➢ Sogakope North CHPS

- 4 CHNs work at the CHPS

- Challenges: In most cases, the communication environment is poor and it cannot be used, and the amount of internet usage is also a burden because you have to pay for it yourself. The facility is not powered so in order to charge the device, you have to go to a different specific location. It is difficult to understand because there are multiple types of Register for the same service, it is difficult to understand how to use E-Tracker, etc.

In conclusion, there were many prioritized issues before the introduction of STI, such as communication environment problems, lack of tablet numbers, and lack of education for usage and input. In addition, some CHPS and Health Center workers said that the feedback on the input information was only a performance review from the DHD, and no practical analysis was performed

Based on the above survey, open innovation theme candidates were organized as shown in the table below, and discussions were held with GHS and the JICA Ghana office. As a result, it was decided to consider a hackathon that utilizes GHS open data as the first candidate.

Candidate themes for open innovation in health (tentative)

Candidate themes	Underlying Challenge	Pros	Cons	Flow
Innovative solutions for data visualizations and new data applications to tackle the challenge of GHS, and to build new products and services utilizing open data	・Data is stocked at GHS, but there is challenge in its utilization	・Challenge tackling GHS's issues	・Risk of GHS not providing necessary data ・GHS requests for MOU and workshops which is a risk to implement in a limited amount of time (a workshop is not included in the scope of the survey) ・Bottleneck for data input and utilization in the field can be internet infrastructure and lack of tablets	Signing of MoU→Workshop, identification of challenge →Data upload data → Hackathon→ Selection→PoC
New solution or business model to deliver necessary information and quality care to pregnant women and mothers especially in rural areas (touching upon existing or past related projects such as MOTECH)	・MCH handbook is delivered however necessary information does not reach certain women due to language barrier ・Challenges in pregnant women receiving timely care ・Follow-up of patients at health facilities is costly in terms of time and cost ・Challenges quality of services and attitude of health workers	・Challenging one of the biggest challenges in health	・It is not clear whether new solutions will come out (however it is usually so for all OI events) ・ Challenges in the quality of services is not very clear yet	Event → Open application in Japan and Ghana → Selection → PoC
Solution to improve internet and electricity infrastructure at rural health facilities	・Lack or weak internet communication in rural health facilities is the bottleneck for slow digitalization of health information and services	・Challenging one of the biggest bottlenecks for digitilization	・Need to identify stakeholders	
New solution for utilization and elimination of plastic waste	・Plastic waste poses a serious threat to the environment as well as increasing the risk of flooding	・The challenge is simple to understand, allowing many stakeholders to hold interest	・UNDP has conducted similar event last year ・Have not yet communicated with UNDP and MESTI	

Figure 3-10   Candidate theme for OI

Source：JICA Survey Team

Ghana Open Data Challenge Hackathon in Health – solving social problems utilizing open data

Event concept and plan

Objective

Improving analysis and utilization of available data is a challenge in Ghana. Through "Ghana Open Data Challenge Hackathon", data scientists, developers, etc. will develop innovative solutions for data visualizations and new data applications to tackle the challenge and to build new products and services.

When

May - June, 2020

Where

Incubation Hub in Accra (ex. Accra Digital Centre)

Who

・Government officials (GHS, district health management teams, etc)
・Data scientists, software developers, entrepreneurs, university students, etc. in Ghana and in Japan

Themes

・Improving data visualization/analysis
・Improving user experience for data input
・New products and services

How (tentative)

Date	Program	Participants
May 12th (Tue) 9:00-12:00	Open data training and open data upload challenge - Opening by GHS and JICA - Training on importance of open data and its utilization, how to upload the data (Mobile Web Ghana)	GHS (confirm participants)
May 14th (Wed)- May 20th (Wed)	Data upload by GHS	
May 27th (Wed) 9:00-17:00	(AM) - Opening by GHS and JICA - Explanation of the datasets and expectations - Pitching of ideas, team-up (PM) - Hackathon	GHS, data scientists, software developers, entrepreneurs, university students, etc.
May 28th (Thu) 9:00-18:00	(AM) - Hackathon (PM) - Pitching of ideas - Selection and awarding	Same as above

Figure 3-11   Hackathon utilizing open data

Source：JICA Survey Team

(2) Survey in Japan （from March 2020）

Despite the above survey, due to the outbreak of COVID-19, the priority of implementing open innovation in the above themes of GHS was lowered, and it became necessary to reconsider the theme.

Therefore, we investigated the possibility of setting a theme related to plastic waste, which was mentioned as an option in discussions with local stakeholders. However, it was discovered that UNDP plans to hold an open innovation challenge focusing on plastic waste in Ghana in July, so it was decided to consider a different theme. (As will be described later, we have decided to collaborate with Nelplast, a startup which develops and manufactures paved bricks from recycled plastic and sand locally, in the KOSEN open innovation challenge.)

Since March, the outbreak of COVID-19 has forced JICA project experts to evacuate to Japan, causing problems such as temporary suspension of the project. Since it is a high-priority issue common to all JICA projects, the survey team proposed to change the theme of open innovation to "innovation that can provide effective technical guidance to sites in developing countries even under travel restrictions." Since the consent of the parties concerned was obtained, selection of a project with high needs for such solution to conduct the demonstration, and specific needs hearing from the target project was conducted.

Criteria for selecting collaborative projects are as follows: (1) projects with needs of on-site training which is difficult to accommodate with ordinary online conference tools, (2) projects that can easily obtain the cooperation of counterparts and experts regarding the implementation of demonstrations, (3) projects with urgent need for implementation, and (4) projects that can secure minimum internet connectivity. As a result of discussions with the JICA Ghana Office, "Surveillance and Laboratory Support for Emerging Pathogens of Public Health Importance in Ghana" was selected as a candidate. In addition, assuming the introduction in the JICA project after the demonstration, it is desirable to perform the demonstration in multiple projects and verify from various angles. Therefore, as a result of soliciting projects with demonstration needs related to this theme through the JICA Africa Department, interest was expressed by Zambia's "Project for the epidemiological research on zoonotic virus infections in Africa" and " Market-Oriented Rice Development Project（MOReDeP）".

As a result of hearing specific needs and assumed demonstration scenes from these project experts, the theme was set as described in "3.2.2 Call for Solutions".

3.2.2 Call for Solutions

A website was set up for registration and PR. The following is an excerpt from the open call for solutions.

CHALLENGE

Technology to Facilitate Remote Communication for Smooth Implementation of Technical Guidance

Possible approaches might include, but not limited to:

- AR/VR technologies with wearable devices which allow users to share their fields of view and work hands-free;
- service contents designed to support remote communication
- Robots, etc., which facilitate users' seeing the on-site situation remotely

BACKGROUND

JICA provides cooperation to 148 developing countries in Africa, Asia, Middle East, Latin America, etc. Every year, JICA has dispatched around 10 thousand experts, 8,500 survey members, 1,000 volunteers and has received around 15 thousand trainees from developing countries to Japan.
However, due to COVID-19, the experts and volunteers have been forced to evacuate and dispatching of survey teams and hosting of trainees in Japan have been suspended, causing disruptions to the smooth implementation of the projects.

This has led to demand for solutions that allow provision of effective technical guidance even with international travel restrictions still in place. Specifically, with video calls that rely on regular webcams, it is hard for participants to share fields of views as they actually perform their work, which makes it difficult to achieve training results equivalent to those achieved by on-site training, and solutions based on a different approach are needed.

JICA has therefore decided to make a global call for proposals on innovative solutions which can enable effective technical guidance remotely from Japan in a smooth manner, as a replacement of conventional cooperation, which has been provided directly on site in developing countries or in Japan.

WHY PARTICIPATE

- JICA will provide Proof of Concept (PoC) opportunity in JICA's field in Africa, and the PoC fund of up to 5 million yen will be provided
- If the technology is established following the PoC, the solution may potentially be applied across Africa or developing countries in other regions where JICA provides cooperation
- Potential PR support by JICA

POINTS TO CONSIDER

- As JICA's fields include places with weak internet connectivity, JICA welcomes solutions that can be applied in such environment or proposals with combination of solutions which can secure connectivity
- As JICA provides cooperation in 148 countries, it is desirable that the proposed solutions are easy to use
- JICA expects the proposers to customize/develop a solution flexibly according to its needs, rather than merely providing devices

PoC

- PoC period：3 months between January to June 2021
- As it is currently planned, PoC for the proposed solution will be conducted in multiple settings, including, between the Noguchi Memorial Institute for Medical Research in Ghana and universities / research institutions in Tokyo, and between researchers on rice cultivation of the Zambian Ministry of Agriculture and experts in Japan. Please see details in "PoC Scenarios"
- The device is planned to be sent to the field in Africa and the PoC will be conducted remotely

PoC SCENARIOS

【Ghana: Infectious Disease Control】

The Noguchi Memorial Institute for Medical Research in Ghana (hereinafter referred to as "NMIMR") was established in 1979 with the cooperation of Japan, and now plays an important role as a central base for infectious disease control not only in Ghana but also in West Africa. JICA has dispatched Japanese experts for many years to provide various technical cooperation in infectious disease control and research areas, and also invited researchers from NMIMR to Japan to implement training programs and has contributed to improving its capabilities.

Currently, JICA implements "the Project for Surveillance and Laboratory Support for Emerging Pathogens of Public Health Importance" at NMIMR with the collaboration of the Institute of Medical Science of the University of Tokyo, National Institute of Infectious Diseases in Japan and Ghana Health Service which is in charge of managing hospitals and diseases in Ghana. In order to strengthen infectious disease surveillance capabilities in Ghana, the project is jointly conducting genetic analysis of pathogens found in disease surveillance and analysis of their relevance to pathology, between Japan and Ghana.

However, due to COVID-19, dispatch of Japanese experts to Ghana and training of NMIMR researchers in Japan have been suspended. With video calls that rely on regular webcams, it is hard to convey the situation

in the laboratory or specific laboratory techniques, which makes it difficult to achieve training results equivalent to on-site technical guidance. Therefore, an effective solution for implementation of trainings remotely in the area of infectious disease control is being required.

- Sites of application and number of users:
  - ・Sites: Up to 3 sites; 2 in Japan and 1 in Ghana
  - ・No. of users: Up to approx. 8; 3 in Japan and 5 in Ghana
- Users: Researchers on both Japanese and Ghanaian sides; They are not engineers and therefore not skilled at technical operation.
- Internet speed in Ghana:
  Approx. 54.4 Mbps upstream / 1.7 Mbps downstream (as of the time of measurement). Although a fiber optic network has been built, it is shared across the users within the institute, which may slow down speeds. It is planned that they will have mobile routers as a backup.
- Usage: To provide technical guidance on medical research from Japan. For instance, the following trainings are being considered
  - ・Training on genetic analysis of drug-resistant HIV
  - ・Training on analysis of the intestinal flora
- Site of use: Indoor laboratory within the institute
- Language of communication: English; Translation and other language support for the successful proposer during the verification testing may be considered.
- The verification testing is expected to take place for a period of 3 months.

【Zambia: Infectious Disease Control】

The School of Veterinary Medicine of the University of Zambia (hereinafter referred to as "UNZA") was established with the support of Japan in 1985. Since then, Japanese experts have been dispatched and trainees have been accepted for many years to strengthen veterinary education in Zambia and measures against zoonotic diseases. UNZA now functions as a base laboratory for infectious disease control in the region, and plays a central role in diagnosing the new coronavirus, shown by UNZA testing the majority of samples in Zambia.

Currently, JICA implements "the Project for Epidemiology of Zoonotic Virus Infections in Africa" at UNZA in collaboration with Hokkaido University Research Center for Zoonosis Control, to elucidate the natural host of the virus and its transmission route as well as to build capacity of infectious disease control personnel in Zambia. In particular, genetic analysis of viruses is the key to taking effective measures against infectious diseases. By comparing and analyzing the gene sequences of viruses detected in patients, we can grasp the origin and transmission route of viruses, trends of epidemic viruses, etc., and obtain epidemiological findings essential for planning effective epidemic prevention measures. Therefore, the project has newly introduced advanced research equipment necessary for next-generation sequence analysis and was planning to implement training for next-generation sequence analysis at UNZA. However, COVID-19 forced the evacuation of experts and the cancellation of business trips.

UNZA has many excellent researchers who have completed a doctoral course at Hokkaido University, but none have conducted next-generation sequence analysis. Therefore, the training is an urgent issue for the countermeasures against COVID-19 in Zambia, and there is a strong demand for new solutions that are effective for remote technical guidance.

- Sites of application and number of users:
  - ・Sites: Up to 2 sites; 1 in Japan and 1 in Zambia
  - ・No. of users: Up to approx. 8; 3 in Japan and 5 in Zambia
- Users: Researchers on both Japanese and Zambian sides; They are not engineers and therefore not skilled at technical operation.
- Internet speed at UNZA: Out of 3 measurements, the maximum value is 16.29 Mbps for downlink and 5.4M bps uplink, and the average value is 8.62 Mbps for downlink and 1.73 Mbps for uplink. It is planned that they will have mobile routers as a backup.

■ Usage: To provide technical guidance from Japan. For instance, the following trainings are being considered:
　・Training on next-generation sequence analysis of COVID-19
　・Training on maintenance of laboratory
■ Site of use: Indoor laboratory within UNZA
■ Language of communication: English; Translation and other language support for the successful proposer during the verification testing may be considered.
■ The verification testing is expected to take place for a period of 3 months.
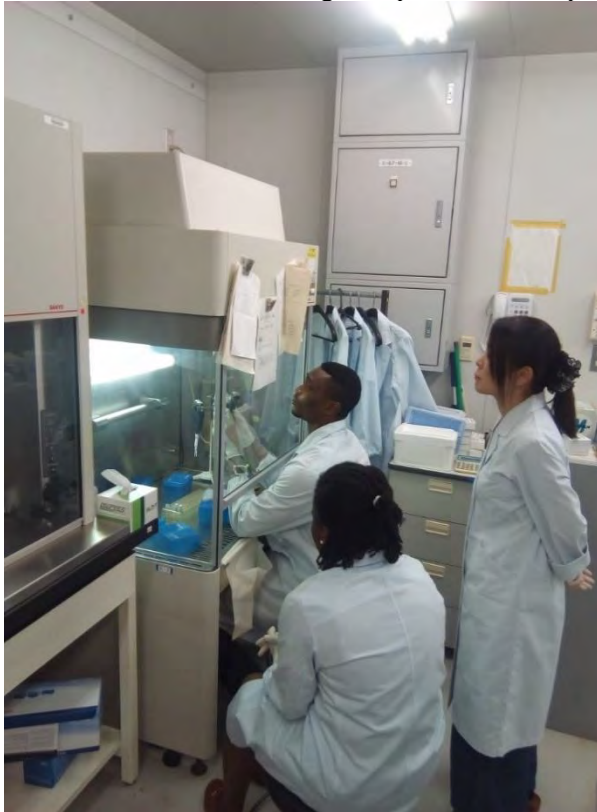
【Zambia: Agriculture】

In Zambia, about 67% of the labor force is engaged in agriculture, and the agricultural sector accounts for 9.8% of GDP. For many years, Zambia has implemented an agricultural policy that emphasizes maize, which is the staple food, but from the perspective of food security, Zambia is putting more emphasis on rice cultivation with the aim of breaking away from the planting system that is extremely dependent on maize. However, due to the immaturity of rice cultivation technique and post-harvest processing technique, productivity is low; domestic demand cannot be met by domestic supply, and the shortfall is imported from neighboring countries and Southeast Asia.

Currently JICA implements "Market-Oriented Rice Development Project", which aims to promote research and development and dissemination of technology on rice farming, and raise farmers' incomes through improving market access by rice farmers. Activities are still underway, but the influence of COVID-19 has forced Japanese experts to evacuate to Japan. One of the challenges of local activities in the absence of Japanese experts is technical guidance to Zambian rice researchers in the research field. Normally, at the rice research laboratory in Zambia, Japanese experts will tour the field with local researchers and provide guidance on rice growth, pest diagnosis, training methods, etc. Currently, the project is responding by exchanging photos via email, but due to time lags caused by exchanges and gaps in information to be shared, the efficiency and quality of work is significantly reduced. Therefore, there is a need for solutions that contribute to the promotion of smooth remote activities.

- Sites of application and number of users:
  - ・Sites: Up to 2 sites; 1 in Japan and 1 in Zambia
  - ・No. of users: Case 1: 1 in Japan and 3 in Zambia, Case 2: 1 in Japan and 15 in Zambia
- Users: Researchers on both Japanese and Zambian sides; They are not engineers and therefore not skilled at technical operation.
- Internet speed in Zambia:
  4.5G LTE. Tethering from 4G smart phone is planned.
- Usage: To provide technical guidance from Japan. For instance, the following trainings are being considered:
  - ・Case 1) Technical guidance during field tour of rice research field by Zambian researchers
  - ・Case 2) Technical training towards local rice researchers in Zambia
- Site of use: Case 1) Outdoor, Case 2) Agriculture research institute of Ministry of Agriculture (Indoor), Rice research laboratory (indoor)
- Language of communication: English; Translation and other language support for the successful proposer during the verification testing may be considered.
- The verification testing is expected to take place for a period of 3 months.

3.2.3 Screening Result

(1) Applications

A total of 24 companies applied from 6 countries including Japan, Canada, Italy, the United States, Belgium and Finland. Of these, 6 were large companies, 6 were small and medium-sized companies, and 12 were venture companies. Of the applications, 19 (more than 75%) were solutions that combined smart glasses or cameras and apps, 2 were VR training, and 3 were others.

(2) Screening Result

The screening was conducted based on the above criteria, and online interviews were conducted to the 6 companies that passed the primary screening. The online interview was implemented in order to deepen the understanding of both JICA and the applicant company, and in particular, for the applicant company to deepen the understanding of the needs and the site situation so that the solution and demonstration plan can be brushed up towards the final selection.

As a result of the screening, a Finnish venture that proposed the use of passive glasses, which do not have communication functions in consideration of the issues of smart glass certification and software capable of smooth communication under limited internet environment was selected.

3.2.4 Poc implementation

(1) Outline of PoC

We verified the usefulness of the remote technical guidance solution combining smart glasses, remote communication software, and an external camera kit in the following training programs scheduled in the three projects in Ghana and Zambia. In particular, we verified whether the usefulness of the solution could be recognized in the environments of Ghana and Zambia, where the internet is relatively unstable.

➢ Ghana "the Project for Surveillance and Laboratory Support for Emerging Pathogens of Public Health Importance": Training on genome analysis of drug-resistant HIV virus and training on analysis of intestinal flora

➢ Zambia "the Project for Epidemiology of Zoonotic Virus Infections in Africa": Training on genome analysis of COVID-19

➢ Zambia "Market-Oriented Rice Development Project"": Remote technical guidance on rice research, farmer training

The PoC was conducted using Iristick GI smartglass which is used by connecting to a smartphone (the smartglass itself does not have a communication function), Augumenta's SmartEyes software, and an external camera kit (for sending static images). The Ghanaian and Zambian counterparts wore the smartglasses and set up the external camera, while the Japanese expert gave work instructions through the SmartEyes web browser.

Figure 3-12   Devices used in this Poc
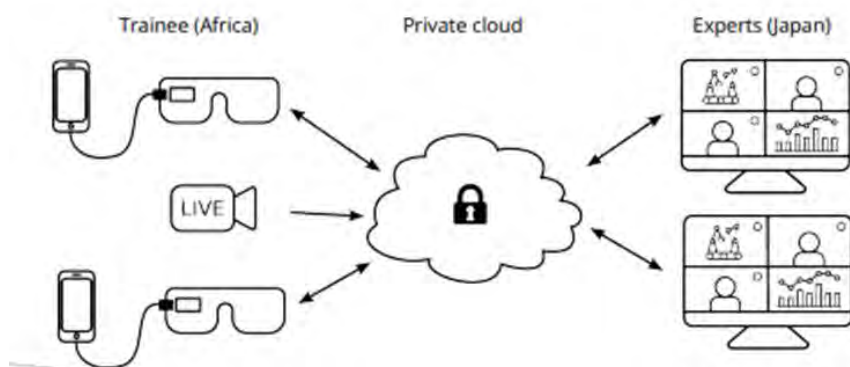
Figure 3-13   Architecture of this PoC

(2) Results

In this PoC, we first conducted training for the people in Japan, Ghana, and Zambia on how to use SmartEyes and smart glasses, and then used them in the training of the above-mentioned projects. After each training and after the PoC itself, we conducted a questionnare to the participants through an online survey and evaluated the results. Also, during the PoC period, support for issues that arose was provided by Augumenta. For example, to address low image quality due to communication speed issues, FPS (frames per second) of the smart glasses and external camera images was adjusted. Also, some functions desired by the project, such as screen share function, was added in the course of the PoC.
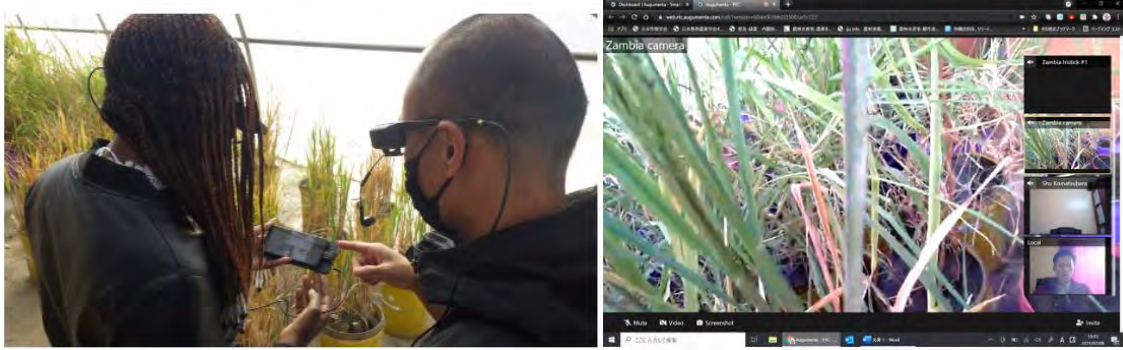
Figure 3-14   Training session

Source: JICA Survey Team

Figure 3-15   Training session

Source: JICA Survey Team
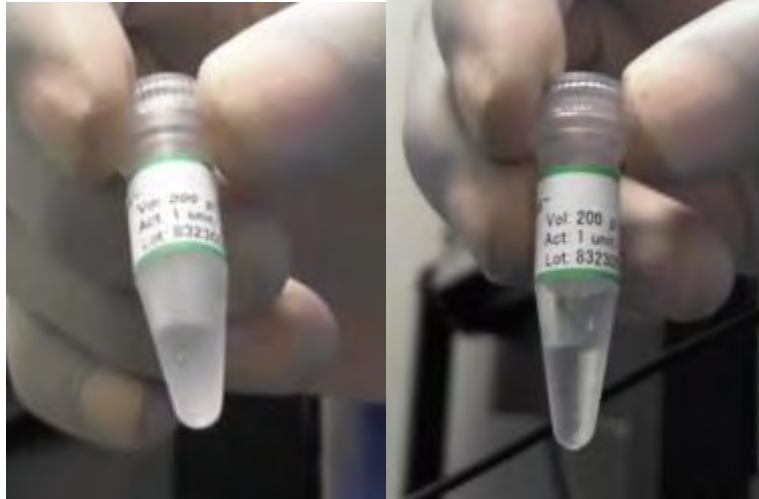
Figure 3-16   Image quality adjustment

As a result of the questionnaire, 81.8% of the participants responded that SmartEyes could replace some of the on-site training in the future, and 54.5% of the participants responded that SmartEyes could be as effective as on-site training. In addition, 63% of the participants would like to continue to use SmartEyes after the PoC, and 18% would continue to use it if it were free. The qualitative comments on SmartEyes were: "very effective in understanding the situation on site," "improves the speed and efficiency of collaborative research," "can get accurate advice in real time," "high economic benefit by reducing travel costs," "difficult to completely replace on-site training, but useful for follow-up and troubleshooting," and "the fact that communication can be done hands-free is useful.
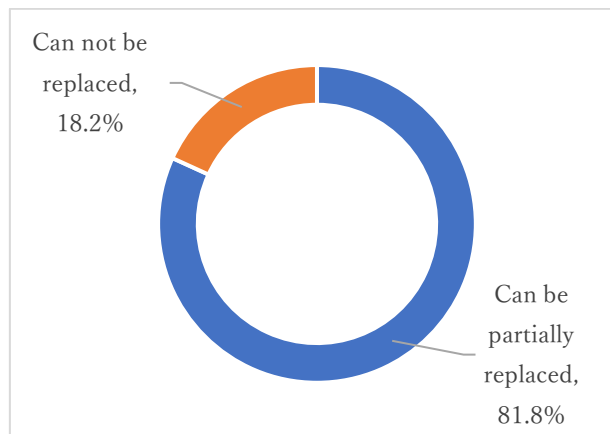
Figure 3-17   Potential for SmartEyes to replace onsite trainings
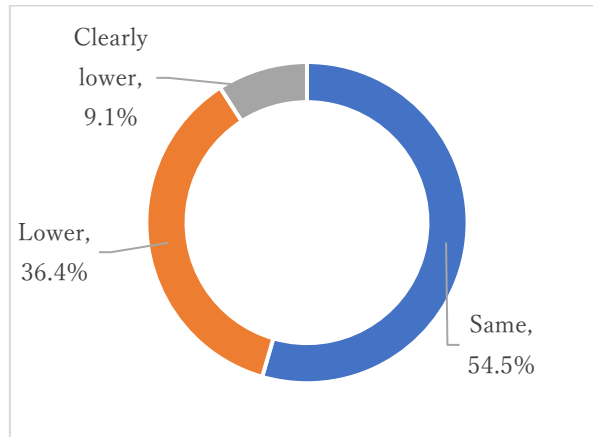
Figure 3-18   **Comparison between SmartEyes and onsite trainings**
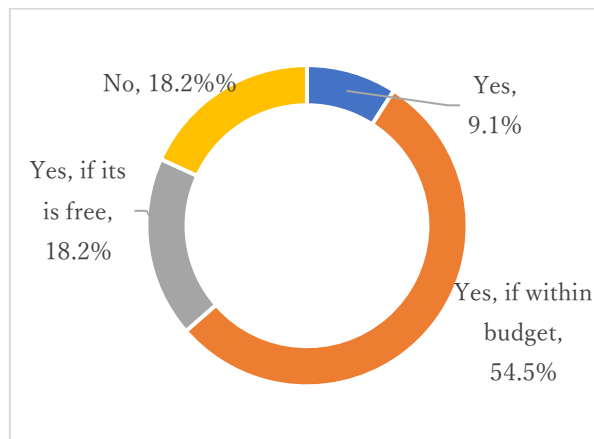
Figure 3-19   **Will to utilize SmartEyes after the PoC**

On the other hand, 91% of the participants answered that they had problems with the internet. Specifically, there were many problems such as interrupted connections and low image quality.

In Ghana, Noguchi Memorial Institute for Medical Research's internet line was initially used, but since we could not secure sufficient connection speed, we switched to a communication plan of MTN, a local telecommunication company. As a result, the internet speed improved and the image quality improved. (Fixed-point internet speed measurements were conducted at each project site prior to the PoC implementation, and although all sites met the minimum communication speed requirements for SmartEyes use, there were large fluctuations in communication speed depending on the time of day.)
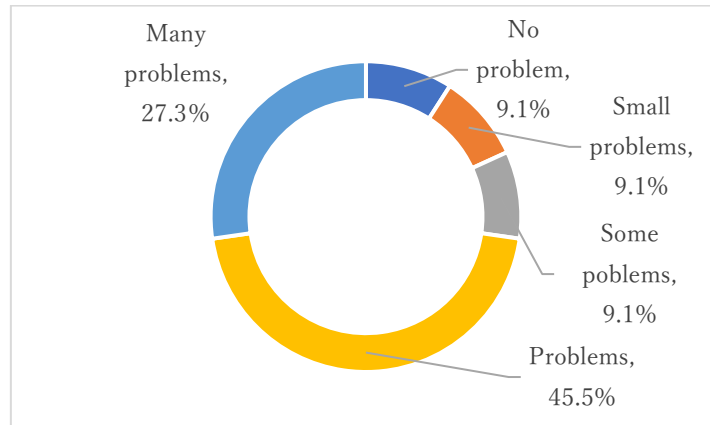
Figure 3-20　　　Internet challenges

The issues identified through the PoC and the proposed countermeasures are shown in the table below.

Table 3-3　　Challenges identified through the PoC and proposed measures

Classification	Challenge	Countermeasures
Initial setting	In this PoC, one of the six domestic institutions needed to adjust its firewall to use SmartEyes. Since it was difficult to adjust the firewall for this PoC, the institution's communication network was not used, and the demonstration was conducted using cell phone tethering. Similar issues may occur in institutions with strict security standards.	Check the firewall requirements beforehand, and check with the IT department to see if there are any issues with implementation. (Note that many of the competing solutions, like SmartEyes, require firewall adjustments for institutions with strict security standards, unless you are using a smart glass platform such as Zoom or Teams.)
	The external camera kit is designed for LAN cable connection and does not allow users to set up Wi-Fi. Since the number of facilities with LAN cable connections was limited, Augumenta had to remotely set up the Wi-Fi connection.	Augumenta plans to introduce a QR code system for external cameras that will allow users to set up their own Wi-Fi.
Connection	Problems such as communication disconnection, low image quality occurred	➢ Conduct trials before full-scale implementation to evaluate whether the system can withstand the local communication environment. ➢ Utilize the most highly rated local communication service (in Ghana, switching from Noguchi's network to a mobile communication company's communication plan greatly improved the internet speed)

		➢ Consider adding a function that allows users to adjust the FPS by themselves.
Sound	Audio feedback occurs when multiple devices are used in the same space.	➢ When turning on the microphone/speaker on one device, turn off the microphone/speaker on another ➢ Mute the audio by default when joining
Function	No chat or screen sharing features.	The screen sharing function was newly introduced during this PoC period. The recording and document sharing functions will be added in the future.
Smart glasses	The Iristick has a relatively long battery life (4.5 hours) for smart glasses, but the project expressed concerns about the lack of charging facilities for outdoor trainings.	Utilize additional battery docking units or USB charging packs
	Cables are in the way	➢ Utilize the belt leather pouches included in the equipment set ➢ Use smart glasses with communication function (see below for points to keep in mind)
	The smart glasses do not focus properly. The person wearing the smart glasses cannot confirm whether the focused image is being sent or not.	Consider introducing a function to take and send photos
Tranportation, Approvals	The smartphone (Google Pixel 4a) used in this study, which is recommended by Iristick, had not obtained type approval in the target country. Therefore, as a PoC, we applied to the regulatory authority for an exemption from type approval and it was accepted.	Verify in advance the local availability of smartphones that have been tested for compatibility with smart glasses.

Source：JICA Survey Team

(3) Deployment plan after PoC

In the beginning of the PoC, the smart glass solution was expected to be deployed in technical cooperation projects if the effectiveness can be confirmed. In fact, the smart glass solution has proven to be effective in monitoring the situation in the field and providing accurate and real-time guidance and is expected to be highly cost effective compared to the cost of travel; it is expected that its deployment be considered in JICA's projects. In particular, it is expected that the solution will be used in the following situations in JICA projects:

-Implementation of training (under travel restrictions)

-Follow-up after training

-Troubleshooting

In the actual deployment phase, the following points should to be considered when considering smart glasses and vendors.

➢ Types of smart glasses

There are two types of smart glasses: a stand-alone type that has a communication function, and a passive type that does not have a communication function and is used by connecting to a smartphone. The characteristics of each type are shown in the table below, and it is desirable to select one according to the needs of each project. In this PoC, there were some requests for wireless, but it should be noted that the stand-alone type has an unfamiliar UI and it is intuitively difficult to switch between Wi-Fi and other operations.

Table 3-4   Features of each smart glass

Indicators	Stand-alone type	Passive type
Operability/UI	△ （unfamiliar UI）	○ （Intuitive operation is possible since the operation is done with a smartphone.）
Battery life	△ （1.5-2.5hours）	○ （4-5hours）
Weight	△	○
Glass display resolution	○	△
Cordless	○	×
Sharing of screens, etc., sent by the instructor among those involved in the field	×	○ （Can be shared via smartphone screen）

Source: JICA Survey Team

➢ Software

As for software, different vendors have different functions and costs, so it is necessary to select a vendor after considering what functions are necessary for each project as well as budget constraints.

Table 3-5   Features of each software

indicators	SmartEyes	Company A	Company B
Supported smart glass types	Standalone Passive	Standalone Passive	Standalone
Communication speed requirements	Minimum：300kbps Recommended：>500kbps	Minimum：512kbps Recommended：1Mbps	Unknown
Support for external cameras	○	○	×
Screen sharing function	○	×	×
Chat function	×	○	○
Recording function	○	×	○
Other functions	Invite participants, share documents, connect with IoT sensors	Invite participants, remotely control cameras	Remotely control cameras, share

		(zoom, take photos, flash), adjust FPS	documents, set workflow
Customer support	Support available in English and French during European business hours	24/7; Japanese support available during Japanese business hours	Unknown
Price	Low	Medium to High	High

(4) Lessons learned

Prior application for permission and product registration with NCA in Ghana and with ZICTA in Zambia are required for the importation of equipment with communication functions. However, in some cases, exceptions can be made for demonstration and testing purposes, and in this study, letters to NCA and ZICTA were issued and permission was obtained before conducting the PoC. In many African countries, it is highly likely that smart glasses are not registered as a product, which may be a hurdle for the introduction of smart glasses in the future. On the other hand, for the purpose of international cooperation, it is recommended to check with the regulatory bodies of the target countries in advance, as exceptions may be taken.

In the private sector, smart glasses are widely used in construction sites, maintenance and inspection sites, manufacturing sites, and other sites and situations where it is necessary to receive instructions in real time while moving hands. In cases where skilled workers and instructors had to go directly to the site in the past, the smart glasses can be used to provide instructions and support from remote locations, which not only reduces the time and cost required for transportation, but also contributes to receiving immediate support when trouble occurs, contributing to work efficiency and productivity improvement. In international cooperation projects, it is expected to be deployed in various situations where it is necessary to receive technical guidance in a hands-free manner, such as receiving guidance on experimental techniques in the field of infectious disease control, remote maintenance of mobile laboratories, maintenance and inspection of infrastructure such as roads and bridges, guidance at manufacturing sites, transfer of skills of experts in agriculture, remote medical care support, etc. As clarified in this PoC, it is necessary to note that it is important to confirm the internet environment in advance because it can be applied only in the field where a sufficient internet environment can be secured. In cases where sufficient internet environment can be secured, it will be possible to reduce travel time and costs and take immediate action in the event of a problem, which is expected to be highly cost-effective and improve the efficiency of technical cooperation.

3.3 Senegal

3.3.1 Theme Selection

⑴ Change in Theme Setting Policy

Initially, surveys were conducted in each field as described in Chapter 2 on the assumption that challenges would be set in the health field and/or the electric power field. However, taking into account the difficulty of traveling to the field due to the influence of the COVID-19 and the high possibility of remote PoC implementation, the policy was changed to set challenges bearing in mind the condition that "to enable smooth implementation of a PoC even when a survey team or a company implementing the PoC cannot visit the site." Then, discussions with JICA Senegal Office were held not only in the health and the electric power fields but also others. As a result, PoC themes were set in cooperation with the ongoing technical cooperation "Senegal River Basin Irrigation Project for Improving Rice Production (Abbreviation: PAPRIZ2)" in consideration of the close relationship with the C/P organization. Since the long-term technical cooperation has been implementing in the agriculture field with the National Company for the Development and Exploitation of the Senegal River Delta, Senegal River and Faleme Valley (SAED), it seems feasible to collaborate with SAED to secure the cooperation system for the provision and implementation of the PoC implementation site. An overview of PAPRIZ2 is described below (The summary information is also posted on the public offering Web site.).

About the Project for Improvement of Rice Productivity in the Senegal River Valley (PAPRIZ2)

- o   Project: Technical Cooperation
- o   Challenges: Agricultural/Rural Development
- o   Duration: May 2016 - November 2021
- o   Outline:
  Senegal is one of the leading rice consuming countries in West Africa, but the self-sufficiency rate of domestic rice is low, and most of it depends on imports. In the national plan "the Accelerated Programme for Agriculture in Senegal (2014–2018)", increasing domestic rice production is an urgent issue to achieve rice self-sufficiency by 2017. This cooperation will formulate a medium- to long-term development plan for the rice cultivation sector in the Senegal River basin, as well as cultivation technology, irrigation infrastructure maintenance, and agricultural service providers in the Senegal River basin, especially in Dagana and Podor provinces where rice cultivation is prosperous. This will improve the production and quality of rice and contribute to the increase in domestic distribution.

Source: https://www.mofa.go.jp/mofaj/gaiko/oda/files/000411141.pdf
Source: https://www.jica.go.jp/oda/project/1400518/index.html

Harvesting and threshing in a small-scale irrigation scheme. It is expected that the quality of paddy will be improved by instructing the timely harvest through the rice cultivation training by the project

⑵ Identifying Issues

Consultations were held with JICA Economic Development Department, which is responsible for PAPRIZ2, to identify issues in the agricultural sector. In February 2020, JICA Economic Development Department

held a meeting with severl JICA experts in an agriculture sector working in Sub-Saharan Africa (mainly experts for CARD and SHEP) and JICA local offices in each country to exchange opinions on the potential use of digital technology (The name of the meeting is "Exchange of views with Sub-Saharan African agricultural experts and JICA loacl offices on new projects "Use of disruptive technologies to support agriculture"). The ideas mentioned in the meeting were as follows:.

Category	No	Issue	Details (statement by JICA experts)	Country where relevant JICA experts work
Data collection services (Although accurate data cannot be obtained, it can be effective if data can be obtained.)	1	Measurement of field area and yield	• Is it possible to use satellite information, weather information, and map information to grasp the area of fields and yield (For timely information gathering during floods)? • Whether it is possible to grasp the field area and yield using smartphones, GPS and drones at the site (For timely information gathering during floods).	Kenya, Senegal, Tsukuba Center, Mozambique
	2	Basic information gathering	• The fundamental problem is unavailability of basic information. A system is needed in which local extension workers can gather information and inputs data in the field.	Ethiopia
	3	Utilization of big data	• With the introduction of computerization of subsidies and the establishment of a farm registration system, if revenue and harvest data can be linked, the government can sell the data to the private sector as big data.	Zambia
	4	Harvest prediction	• I hope companies like AGRIBUDDY will be interested in the African market.	Rwanda
Platform related services (It is difficult to match farmers with buyers and markets, but it will be beneficial if we can do it properly.)	5	Matching farmers with buyers and markets	• There are several online agricultural platform services, but there are many challenges, including business models, reliability, usability, assurance of information accuracy, and assurance of crop quality and quantity.	Zambia, Kenya
	6	Building trust	• Without the confidence of both farmers and buyers, buying and selling on agricultural platforms and e-commerce sites will not be widespread. In Zambia, iDE supports a mechanism similar to Uber Rating. Is it possible to create a sense of trust through AI?	Zambia, Kenya, and Tsukuba Center
	7	Sharing information among farmers	• Few farmers share information with each other. Can we build trust by sharing buyer information among farmers?	Mozambique
Technical guidance services (More effective and efficient technical guidance)	8	Improvement of agricultural technology	• The improvement of techniques of skilled farmers using AI has already been discussed in Japan.	Zambia
	9	Judgment of the growth status	• It would be nice to have a service in the future that can determine the growth status of a crop when it is photographed with a smartphone.	Sudan
	10	Support for extension activities	• Tools to support extension activities such as monitoring and data collection are also necessary.	Ethiopia
Logistics services	11	Logistics	• The issue of logistics should also be considered.	Tsukuba Center

Figure 3-21   Internet challenges

Source: Created by the survey team based on materials provided by JICA.

At the meeting with JICA Economic Development Department, the survey team proposed several ideas for utilizing digital technologies in the agricultural field, and recommended the PoC implementation in cooperation with CARD and SHEP, considering the PoC implementation policy and the ease of securing a PoC site, in addtion, and the possibility of cross-country deployment after PoC.

No	Proposed Agricultural PoC Implementation Ideas	Remarks
1	Implementation of technologies useful for rice cultivation in conjunction with CARD	• In collaboration with technical cooperation projects, it is easy to secure a site for PoC.
2	Implementation of technology in cooperation with SHEP to help small farmers	• **Expect to expand to multiple countries after PoC**
3	Collaboration with WFP	• There is ncertainty, probably
4	Traceability of cacao using blockchains	• Potential collaboration of cacao platforms and research projects
5	Utilizing big data through collaboration with JICA STI/DX Division (Analysis of past JICA reports (Africa's agricultural sector only) using AI to derive lessons that can be used in the future, etc.)	• It may depend on the progress of the activity by JICA STI/DX Division • Not a field PoC
6	Supporting the implementation of technologies to support labor-saving and high-productivity farming using AI analysis on the assumption of supplementary support for financial cooperation such as ODA loans	• Excerpt from "Co-Creation Digital Development to Achieve Society 5.0 for SDGs (January 2020)" created by Nippon Keidanren and JICA • Also described in the separate Use Case List of "Co-Creation Digital Development to Achieve Society 5.0 for SDGs (Page number in parentheses) • Picking up Japanese Companies' Solutions only
7	"Visualisation" solution for agricultural field situation - Subscription Cloud Application with Reduced Initial Investment - (Page 48)	
8	"visualisation" and "Automated farming using AI" solutions for agricultural field conditions - subscription-based cloud applications with reduced initial investment- (Compatible crops: Processed tomatoes only) (Page 38)	
9	Agriculture to Support Agricultural Development in Developing Countries by Utilizing E Voucher (Page 40)	
10	Advancement of bee keeping industry by utilizing satellite data (Page 42)	
11	Transportation service using robots that fit distribution locations (Used in ports, land border and customs facilities, freight railway terminals, freight truck terminals, agricultural warehouses, etc.) (Page 102)	

Figure 3-22   Proposed Use of Digital Technologies in Agriculture

Source: JICA Survey Team

In addition to the above discussions with the JICA Economic Development Department, JICA Senegal office and PAPRIZ2 experts were interviewed to identify the specific issues that PAPRIZ2 is facing. As a result, the following issues were identified.

- Improving the efficiency of extension and monitoring activities by extension workers (IT for monitoring)

- Yield prediction

- Leveling of paddy field

- Floodgate control

- Measures against bird damage

- Agricultural machine database management

- Utilization of remote sensing technology in basic research

(3) To Narrow Down the Issues

Based on the above process, the issues from PAPRIZ2 were narrowed down from the following viewpoints.

- Affinity with OI: Should you be looking for a solution as an OI instead of a normal procurement?

- Number of solutions: Are there several available solutions to the challenge?

- Appeal to applicants: Is it an attractive theme for applicants?

- Possibility of demonstration under COVID-19: If local travel is not possible, it is possoble to implement PoC remotely?

- External factors: legal regulations, Internet environment (electric power and communications conditions), seasons (relation to the agricultural period)

- Interest of JICA's Economic Development Department: If the PoC is successful, is it possible to collaborate with other JICA projects?

As a result, the following two issues were selected.

- Introduction of IT for extension and monitoring activities by extension workers

- Yield prediction

Figure 3-23　　Identify PoC Challenges

(4)　Materialization of Issues

Detailed interviews were conducted with the PAPRIZ2 experts and the PAPRIZ2 implementing agency, the Public Corporation for the Development of the Fareme Basin in the Senegal Delta and Senegal (SAED), in order to present more specific issues of the two identified issues.

The efficiency of extension and monitoring activities is considered an important issue within SAED becauase SAED does not have a method to cleary monitor the activities of each agricultural extension worker. In the future, SAED would like to introduce tablets for agricultural extension workers, and plans were being considered to digitize activities currently being conducted using printed paper named "Extension and Monitoring Sheet". When SAED introduces tablets, in addition to digitization of data collection in extension and monitoring activities, it examined the possibility of multiple approaches such as visualization of extension and monitoring activities (to understand the activities of individual extension workers), efficient technical guidance and training, and timely pest and weed control by utilizing digital technology. Therefore, as a PoC theme, it was decided to set "Digitization of Extension and Monitoring Sheets" as an essential problem to be solved, and additionally to seek a solution for effective use of tablets.

Next, the need for yield prediction was confirmed. In particular, the need is not only to predicts yields, but also to provide farmers with accurate and timely weather information in order to ensure yields by enabling farmers to take appropriate measures (such as cultivation planning and decision making on the need for irrigation) based on weather information. Therefore, it was decided to set one more theme to seek a feasible solution for weather forecasting and providing farmers with appropriate advice (advice which is based on efficient rice cultivation model).

3.3.2　Call for Solutions

A public relations and registration website was set up for this event. The following is an excerpt from the public offering.

(1)　Innovation for Effective Use of Tablets Designed for Rice Farming Support

CHALLENGE

"Innovation for effective use of tablets for agricultural extension workers"

(Examples of possible solutions)

- Information collection on irrigated rice farming using tablet computers
- Solutions for more effective use of tablet computers

BACKGROUND

JICA has conducted continuously agricultural supports of rice production in Senegal and, at present, the Project for Improvement of Rice Productivity in the Senegal River Valley (PAPRIZ2) has been underway since 2016. This project has supported Programme National d'Autosuffisance en Riz (PNAR), a part of the Accelerated Programme for Agriculture in Senegal (2014–2018), which was a state-run plan by the Senegalese government that aimed to increase the yields in rice production. Especially, it has provided cooperation in such fields as farming technologies, irrigation infrastructure maintenance and management, rice milling, and agriculture-related services, with an aim to increase Senegalese rice production: https://www.jica.go.jp/oda/project/1400518/index.html

The National Company for the Development and Exploitation of the Senegal River Delta, Senegal River and Faleme Valley (SAED), which is an organization conducting PAPRIZ2 and responsible for promoting the development of irrigated farming on the left bank of the Senegal River, plans introducing E-Extension/Monitoring, which uses ICT for promoting and monitoring rice production.　As one proposal, tablet devices are distributed to all agricultural extension workers (about 60 persons) as a tool to implement their technical promotion at yield. In addition, there is a plan to input the questionnaire (extension/monitoring sheet) into the tablet and send it to the SAED headquarters for effective and efficient use of the data.

In this challenge, the above mentioned tablet applications will be realized through demonstration experiments, and further possibilities for effective use of the tablets will be solicited. (Examples of effective use include extension and monitoring management to visualize the activities of extension workers, diagnosis of pests and diseases and weed control methods using images of crops, delivery of agricultural technical guidance content for extension workers and farmers using tablets, online training, etc.)

WHY PARTICIPATE

- o JICA will provide Proof of Concept (PoC) opportunity by providing the PoC fund of up to 3~5 million yen
- o If the PoC is successful, there are possibilities for technologies/services to be introduced in JICA projects (PAPRIZ2, etc.)
- o JICA will support the PoC by introducing the government agencies and public institutions in the country

POINTS TO CONSIDER

■ **Where the solution is to be used:**
Upland rice fields in the Senegal River basin (approx. 80K ha. 44K ha for dry-season cropping and 25K ha for rainy-season cropping in 2015/2016) in Dagana and Podor Province, Saint-Louis Region, Senegal. In this area, high-yield paddy rice　（Sahel series）　is grown.

■ **Users：**
Agricultural extension workers who are engaged in activities for promoting technologies, supporting for

management, and monitoring rice farmers (approx. 60 agricultural extension workers are employed by SAED and receiving training from JICA and other organizations). They have a degree of knowledge in agriculture but are not expert; likewise, their command of ICT devices is of a level comparable to that of beginner users.

■ Communications environment in the area:
In Senegal, there are a lot of areas where communications environment is weak so it is welcomed to propose solutions to use in poor communications environment. The office where the agricultural extension workers are on standby is within the area covered by mobile networks (4G), and the office also has the Internet access (downstream bandwidth of 200 kbps) depending on area and conditions. In agricultural fields away from town, 3G service is generally available. However, considering cost and stability of communications, it is desirable to carry out offline certain or all tasks like inputting data.

■ IT literacy among agricultural extension workers:
Approximately 30–40% of the agricultural extension workers are smartphone users, with the rest being feature phone users. All of them can use mobile phones, including smartphones, with ease. Some of them have in the past received training on PC use provided by other donors, they are of beginner level.

■ IT literacy among farmers :
Local farmers use so-called flip phones to call and text. They generally do not have access to the Internet on PCs; they may travel a long way from home to use one on very rare occasions.

■ Languages of communication:
Because French is official language in Senegal, it is desirable to provide service in French. French and local languages will be used by the agricultural extension workers; and the local languages, by farmers. It is almost difficult to communicate in English with both of them. If the successful proposer needs translation during the verification testing, the cost of translation services can be included in the PoC budget.

■ Tablets to be used:
Those with 7–10 inch screen size. It is expected that tablets of a model suggested by the successful proposer will be purchased for PoC use within the PoC budget. Each agricultural extension worker currently has a Durabook PC from Twinhead International Corp.

PoC

- o   Verification Period : about three months during February and June 2021
- o   If it is difficult to travel the site because of covid-19, the verification test is supposed to carry out remotely.
- o   The verification site will be the Senegal River basin (a part of total 80K ha),which is the activity site of PAPRIZ2
- o   It will be demonstrated to 5~10 agricultural extension workers, employed by SAED, which conducts PAPRIZ2.

POTENTIAL SOLUTIONS

Please propose combinations of the necessary requirement which is the most needed solution by SAED and solutions which suggest freely like the following examples below.

Necessary Requirement：Digitalization of extension&monitoring sheet

- A solution to replace the paper-based extension&monitoring sheet currently in use with a digital version that allows an electronic collection of extension&monitoring information on a tablet computer. （Printing cost of extension&monitoring sheet is also SAED's problem).
- In the field where farmers cultivate, 3G service is generally available but considering cost and stability of communication, it is better to propose the solutions on the assumption of no connection of Internet at the field.
- The data collected offline is uploaded and managed on the cloud under online environment for example at the office.

Proposal Example １：Visualizing activity of extension&monitoring

- The manager, SAED has needs to strengthen operation and management system for regular extension&monitaoring activity by agricultural extension workers, and effective operation to check outcome of extension&monitaoring.
- If introduced a tool to visualized extension&monitaoring activities, they can enhance effective operation and improve more effective and efficient extension&monitaoring activities.

Proposal Example ２：Effective technical guidance and training

- Tablet computers may be used for technical guidance for agricultural extension workers and farmers. The tablets may enable remote technical training instead of face to face training under disaster of covid-19.
- Especially, SAED has a strong need to efficient technical guidance and training with ICT.

Proposal Example ３：timely control with diseases, pests and weeds

- Diseases, pests and weeds are great enemies of rice farmers.
- If agricultural extension workers find diseases, pests and weeds and advise farmers controlling them timely, the damage of the farmers will be reduced. (for example, by using application which can diagnose pests and diseases of crops based on images of crops.)

Proposal Example ４：Others

- Ingenuity for accurate and appropriate data acquisition.
- Measures for promoting motivation of agricultural extension workers (for example, business model such as point distribution in collaboration with private companies)
- In addition to collecting information through extension&monitoring sheet, further data utilization by collecting additional information

About agricultural extension workers

The following is supplementary information about agricultural extension workers who will be users of tablets and their activities.

- The number of agricultural extension workers： Approx. 60 persons （5～10 persons will be targeted for PoC）
- Objective activity area : the Senegal River basin in Dagana and Podor Province, Saint-Louis Region
- The number of farm households for extension&monitoring：Approx.400-1000 households per an agricultural extension worker.
  - The main purpose of extension&monitoring is to train farming and collect production data, etc.
  - During the last season, extension&monitoring activities for farmers were carried out at least 10 times at the timing of important cultivation activities.
  - An agricultural extension worker visits 3 farms a day for extension&monitoring activities.
  - The extension&monitoring sheet can be download from here.

- o Educational background and work experience of agricultural extension workers: They are mainly 20-30 years old graduated from agricultural colleges or other schools, or older people with extensive experience. They are employed by SAED.
- o IT skills of agricultural extension workers:
  - Approximately 30–40% of the agricultural extension workers are smartphone users (at the rest feature phone users)
  - All of them can make full use of mobile phones (including smartphones).
  - They can operate PCs and each agricultural extension workers currently have a Durabook PC. (Durabook is a laptop PC provided by Agence Française de Développment (AFD). The training to use the PC was also provided for them by AFD.)
  - Agricultural extension workers exchange opinions each other actively on the Facebook group.
- o Communications environment in the activity area of agricultural extension workers: The office within the area is covered by mobile networks (4G), and the office also has the Internet access (downstream bandwidth of 200 kbps) depending on area and conditions.
- o Other specific respect: In agricultural fields away from town, 3G service is generally available.

(2) **Technologies That Support Rice Farmers' Decision-Making on Rice Production such as Weather Prediction**

CHALLENGE

"Technologies That Support Rice Farmers' Decision-Making on Rice Production such as Weather Prediction"

  (Examples of possible solutions)

- • Solutions that support farmers' decision-making by utilizing data related to weather, soil, crop growth etc.

BACKGROUND

In Senegal, JICA's project, "Project for improvement of irrigated rice productivity in the Senegal River Valley (PAPRIZ2)" has been implemented. Concerning irrigated rice production, which is addressed in the project, many farmers keep irrigation pumps in continuous operation, causing high production cost and a

waste of water resources. Accurate predictions of the timing of rainy season and the amount of rainfall, if realized, will enable rainwater to be utilized to solve these challenges.

Also, in Senegal, double cropping of irrigated rice is recommended, and the timing of harvesting of dry season crops affects the start time of subsequent rainy season crops, so if it is possible to predict rainfall in advance as much as possible, It will also be a reference for making a cultivation plan, and the benefits will be greater. In addition, if they can be combined with an efficient growth model for rice (e.g., temperature, water management, amount/timing of fertilization), that will bring a further increase in rice farmers' productivity. For this reason, JICA decided to call for solutions to support rice farmers' decision-making to increase their productivity by making full use of such relevant data as weather, soil, and crop growth

WHAT PARTICIPATE?

- o JICA provides Proof of Concept (PoC) opportunity （JICA covers cost of PoC upto 3~5 million yen）
- o There is a chance that the selected technology can be adopted for JICA's projects if the KPIs are met and the PoC ends successfully
- o JICA will support the PoC by introducing the government agencies and public institutions in the country

POINTS TO CONSIDER

There are many areas in Senegal where the internet environment is weak. Solutions applicable to such environment are preferable.

PoC

- o PoC Period：about three months during February and June 2021
- o If it is difficult to travel to the site due to the covid-19, the PoC is supposed to be carry out remotely.
- o Area of PoC in Senegal: Irrigated farmlands in the Senegal River valley under the control of the National Company of Development and Exploitation of Land in the Delta of Senegal River, and Faleme Valleys (SAED), which include the Saint-Louis Region, the Matam Region, and part of the Tambacounda Region.
- o Solution Users：Several tens of technical officers or agricultural extension personnel of the SAED

  [Details of technical officers]
  - o Job description: Technical works at the SAED headquarters or branch office, for example, maintenance and management of irrigation and drainage facilities, water management, work related to collection and management of meteorological data.
  - o Educational background, etc.: Mainly from agriculture, civil engineering, and science and engineering at the university graduate level or above.
  - o IT literacy and internet environment: Many of them use smartphones and PCs that can connect to the Internet at the office where they work. The internet speed is approximately 5.0 Mbps to 20.0 Mbps.

  [Details of agricultural extension personnel]
  - o Job description: Providing farming and technical guidance to producers directly on farmland.
  - o Educational background, etc.：Mainly those in their 20s and 30s from agricultural colleges and elderly personnel with abundant experience.
  - o IT literacy and internet environment: Approximately 30% to 40% of them use smartphones while the others use feature phones. All of them can use mobile phones, including smartphones. They received computer trainings, however they are at beginner level. The

office is within the 4G mobile network. The Office has an internet environment. The maximum download speed is 200kbps; the communication environment may become poor depending on the location
- o French is required for communication with the locals (English is hardly spoken).
  ※ Interpreter fees may be included in the cost of POC if needed.
- o French is preferred as the operating language for the solutions.

Additional information on the site

- o Cultivation-related schedule in the rainy season of 2019:
    - o Completed loan repayment for dry season crops: late June to early July
    - o Rainy season loan application: Early July to mid-July
    - o Procurement of investment goods such as fertilizer: Mid-July to late July
    - o Sowing: Mid-July to mid-August
    - o Harvest: Late November to early January

    - ❖ The first rainfall of the rainy season of a year in Senegal usually takes place sometime between late June and early August.
    - ❖ PAPRIZ2 promotes double cropping. For dry season crop in 2019, they sowed from mid-February to early March and harvested from mid-June to late June.
    - ❖ For the double cropping, the farmers have to fully repay the loan for dry-season cropping before the start of the rainy-season cropping. Otherwise they cannot get the loan for the rainy-season cropping. It is important to reflect the timing of the cycle of investment and repayment for the double cropping. The proposed solutions are recommended to include a reminder function for rice farming plans.
- o Main rice varieties cultivated in the rainy season: Sahel 108 and Sahel 134 (same as the dry season)
- o Water source during rainy season: Pump irrigation with the Senegal River and its tributaries. Rainwater farming is not practiced
- o Current meteorological forecasting methods: The National Agency of Civil Aviation and Meteorology (ANACIM) provides meteorological data to engineers and the general public using radio, websites, SMS, etc They also provide trainings for farmers' organizations before rainy season, using weather forecasts related to rainfall. During rainy season, they distribute one-day and 10-day weather forecasts everyday. In addition, the AGRYMET (Agrometeorology, Hydrology and Meteorology Committee) collects, analyzes and publishes information on rainfall conditions and the impact on agriculture.

SAED officials

3.3.3 Screening Result

(1) Innovation for Effective Use of Tablets Designed for Rice Farming Support

[Applicant]

A total of seven applications were received from Japan, Senegal, Europe and the United States. Solutions included a mobile app for offline data collection and a web dashboard for real-time data visualization and analysis; multifunctional (satellite images, weather information, farming records, disease management, soil temperature, irrigation, etc.) solutions for optimizing agricultural production using field-installed sensors, satellite imagery, and other technologies; as well as data collection apps, services linked to IC cards and solutions for distance learning.

[Results of the Screening]

A review was conducted in accordance with the evaluation criteria described above, and three companies passed the first screening. Prior interviews were conducted online. Prior interviews were held with the aim of deepening the understanding of both the JICA side and the applicant company side, and in particular deepening the understanding of the on-site needs and conditions by the applicant company side, so that the solution and PoC plan can be refined for the final examination.

As a result of the final screening, Maad SAS was selected as the company that would implement the PoC. In particular, Maad SAS, which has similar project experience in the field, was concluded to be the best, considering not only technical aspects such as convenience in an offline environment and ease of operation taking into account IT skills of SAED staff, but also the degree of familiarity with local conditions and the availability of local language support.

(2) **Technologies That Support Rice Farmers' Decision-Making on Rice Production such as Weather Prediction**

[Applicant]

A total of 14 applications were received from Japan, Senegal, Europe and the United States. The solutions included: a service that applies seasonal forecasts to a rice growth model to provide information on appropriate varieties and optimal seeding, fertilization, and harvest times 3 months before planting begins; a service that specializes in the minimum information needed by farmers and delivers rainfall probability, timing, and rainfall via SMS; and a service that provides water needs (water management, irrigation, etc.) in conjunction with crop models and agro-meteorological models based on UAV image data.

[Results of the Screening]

A review was conducted in accordance with the evaluation criteria described above, and three companies passed the first screening. Prior interviews were conducted online. Prior interviews were held with the aim of deepening the understanding of both the JICA side and the applicant company side, and in particular deepening the understanding of the on-site needs and conditions by the applicant company side, so that the solution and PoC plan can be refined for the final examination.

In the final screening, Japan International Research Center for Agriculture Sciences (JIRCAS) was selected as the organization to implement the PoC. In particular, the review focused on whether it was possible to develop rice cultivation models in addition to providing meteorological information and on their reliability, and concluded that JIRCAS, which has a reputation for its technological capabilities in developing cultivation models and has already been introduced in other countries, was the most suitable.

3.3.4 PoC implementation (tablets for agricultural extension workers)

(1) **Overview of PoC**

In order to examine the efficiency of agricultural extension workers' activities using digital technology, which SEAD had been considering planning for some time, the extension and monitoring sheets (paper-based) introduced in PAPRIZ2 were digitized (converted into tablet application). Specifically, a tablet was distributed to each of the 10 agricultural extension workers of SAED, and a system that allows them to input the records of their extension and monitoring activities on the tablet, and to aggregate and analyze the input information through a web-based dashboard function, was tested for about three months. It is expected

that each agricultural extension worker should be responsible for 20 farmers and input data about farmers' activity from soil preparation to harvesting.
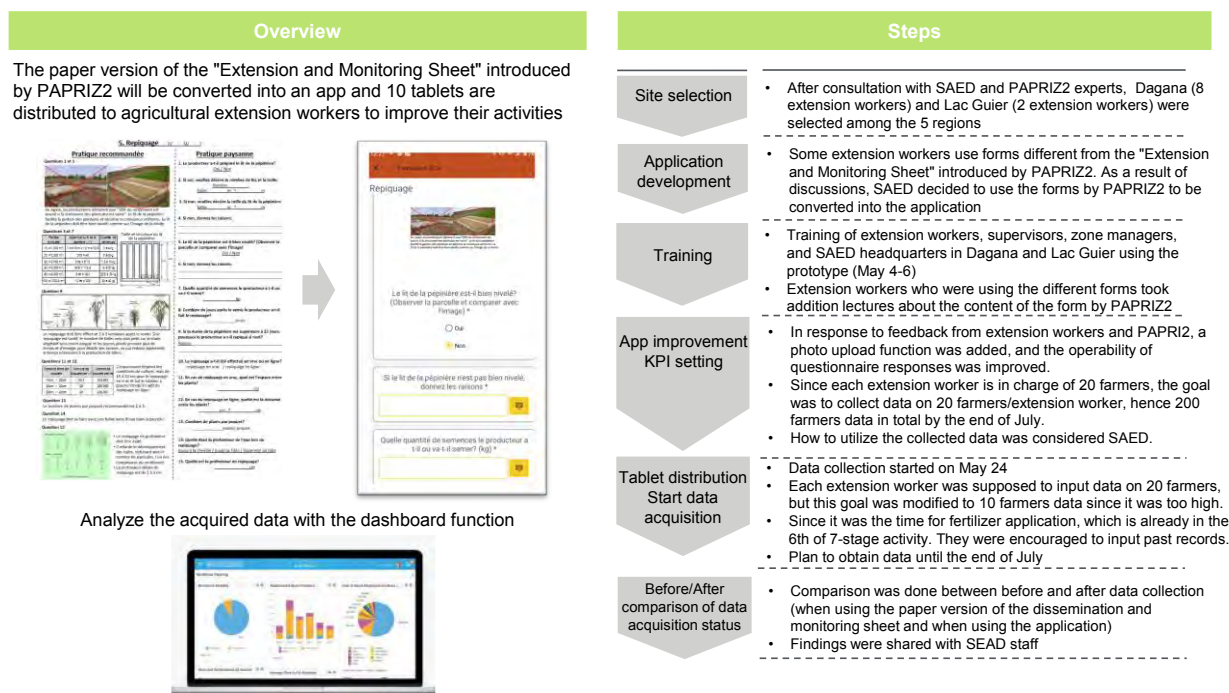
Figure 3-24   Overview of PoC

Source: JICA Survey Team

The main objectives and KPIs of the PoC were then set as follows.

Table 3-6   The Main Objectives of the PoC and KPI

Objective	KPI	Confirmation method (questionnaire question)
Examine whether agricultural extension workers use tablets on a daily basis	Status of tablet use by agricultural extension workers	Percentage of agricultural extension workers who actually entered activity data on at least 5 farmers
	Satisfaction with the digital version compared to the paper version	How easy is it to use? Any problems or dissatisfaction in using the system?
Examine the effectiveness of the solution	Satisfaction of SAED management with the effectiveness of the solution	How has the data collection activity been improved?
Examine improvement of efficiency for management tasks	Time it took for supervisors to review activity data	Has the time been reduced for supervisors to review activity data?

Source: JICA Survey Team

(2)   Results

SAED, Maad SAS, PAPRIZ2 experts, and the JICA survey team held regular weekly meetings to determine the target areas (Dagana and Lac de Guier districts) and agricultural extension workers to distribute the tablets. Maad SAS, with the help of PAPRIZ2 local staff, held meetings with SAED headquarters, field staff, and farmers, and conducted field visits to understand SAED's issues and expectations regarding rice cultivation techniques and the current data collection process, and then began to develop the system. As for the extension and monitoring sheet function for extension workers, the system allows them to input necessary information in seven different forms (farmer registration, soil preparation, sowing, weeding, fertilizer, harvesting, and evaluation) for each stage of farming operations. The dashboard function allows the supervisors and the SAED headquarters to check the information entered by the extension workers, the time of their activities, their travel routes, and locations on a map. After the development of the system, 10 tablets were distributed to extension workers in Dagana and Lac de Guier districts (8 and 2 tablets, respectively), and operational training was conducted for both districts as well as the SAED headquarters on May 4-6. After that, the actual use of the tabets started, but due to their workload for other work, data entry during May was so limited, and data entry was mainly conducted from early June to late July.
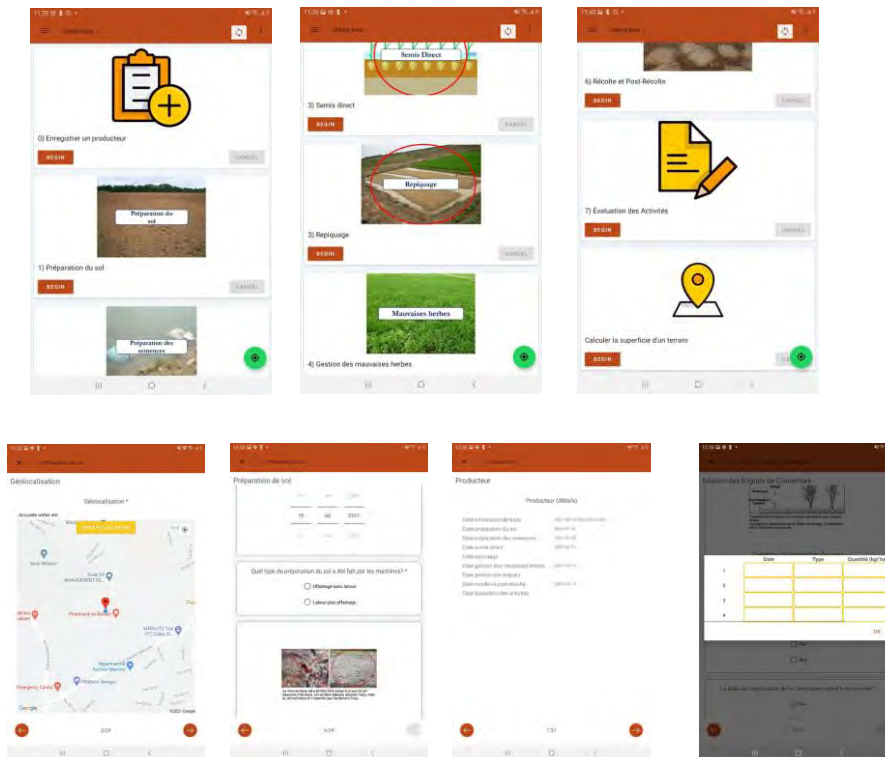
Figure 3-25   Images of Developmed Application

Source: Report by Maad SAS

Figure 3-26　　　Firld Trip by Maad SAS

The obtained data related to each KPI and the results of the questionnaire show high satisfaction with the solution in general, as shown below. Regarding the use of tablets by extension workers, though we initially set a target goal of registering 20 farmers data per extension worker (10 extension workers x 20 farmers data = 200 data registrations), the total data registered was 95 farmers data (15 farmers data per extension worker in Lac de Guiers and 8 farmers data per extension worker in Dagana). However, this is a significant improvement compared to the paper-based extension and monitoring sheet, which only registered 3 farmers data per extension worker. Only one of the 10 extension workers failed to register more than 5 farmers data, and 8 of the 9 extension workers who responded to the questionnaire indicates that they would prefer to use tablets application rather than paper extension and monitoring sheets.
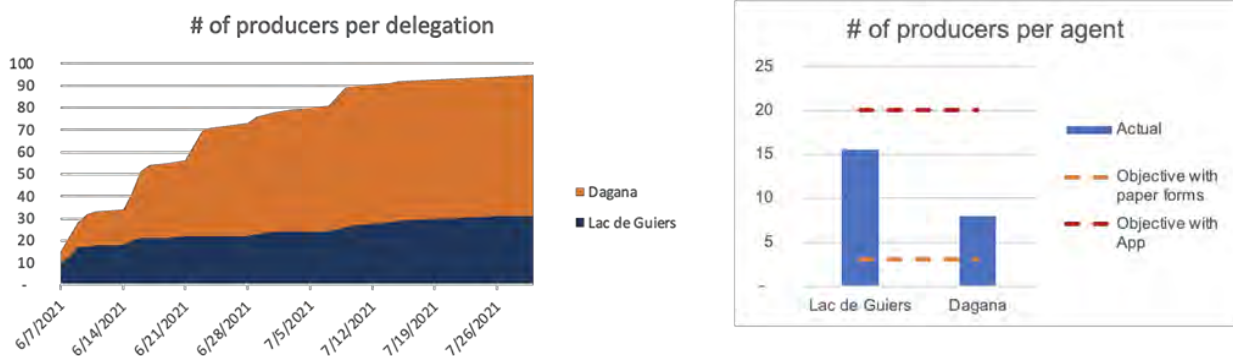
Figure 3-27　　　Number of Registered Farmer Data and Number of Registrations per Extension Worker in Each District

In terms of the effectiveness of the solution, a total of four SAED management and supervisors rated the convenience of the solution as the highest out of six. A total of three supervisors gave positive comments on the solution, such as the ability to better manage the activities of the extension workers and the reduction in the time required to check the data.

Figure 3-28   Questionnaire Result for SAED Management and Supervisors

Source: Report by Maad SAS

Finally, from the perspective of improving the efficiency of administrative tasks, we checked the frequency with which the supervisors check the information collected by the extension workers, and found that the frequency of checking has increased. This may be because the information can be easily checked on the web dashboard of an application, and also because it is possible to refer to useful information such as the time of the extension workers' activities, travel routes, and location of farmers in addition to the entered farmers' information on the screen.
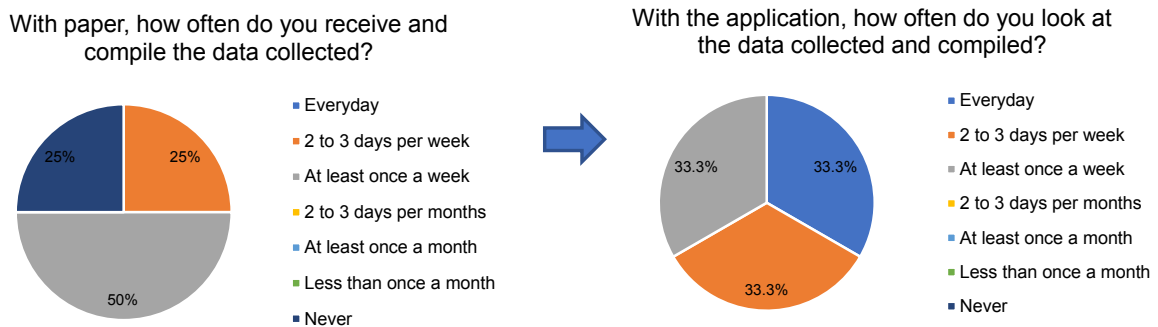
Figure 3-29   Changes in Supervisors' Frequency of Monitoring Information

Source: Report by Maad SAS

(3)   Post-implementation Deployment Plan

The initial assumption was that if the solution proved to be effective in the PoC, the solution would be implemented by JICA project or SAED's own budget. Then, after the PoC, SAED is considering implementing the solution in JICA project, and is discussing with JICA how to fit it into the next phase of PAPRIZ2. The following two proposals were made by Maad SAS for business development after the PoC implementation.

Table 3-7   Business Development Plan After PoC Implementation

Proposed deployment plan	Outline	Required resources and activities
Digitization of extension and monitoring sheets	Further deployment of the content implemented in this PoC to all agricultural extension workers	Tablets, operation training, annual service cost (5,000-10,000 USD)
Support for Digital Transformation of SAEDs	Improve efficiency of overall operations beyond digitization of extension and monitoring sheets	Requirement definition, system development, operation training, tablets, annual service fee (5,000-10,000 USD)

Source: JICA Survey Team

In this PoC, we were able to achieve a certain level of success by digitizing the dissemination and monitoring sheets, but there are still issues to be addressed, such as how to utilize the increased data acquired through digitization and how to deal with changes in the existing business processes due to digitization. Digitization is not just a simple change of tools, such as from paper to apps, but also involves a change in business processes, so SAED's DX support is worth considering as a fundamental measure. Since the next phase of the PAPRIZ2 technical cooperation project is planned after the completion of this PoC, it would be ideal if this kind of initiative is implemented as one of the activities of the next phase.

(4)   Lesson Learned and More

There were three main lessons learned mentioned by Maad SAS.

➢   In order to drive the digitization of operations, it is necessary to have clear responsibility and strong management in the field.

➢   The most difficult part of digitizing an organization like SAED is to ensure that the organization has ownership of the digital tools (i.e., is proficient in using the tools), and should invest in operational training rather than additional investment to add functionality.

➢   Since an organization does not necessarily know all the business processes to be digitized, an iteration period should be set in advance to update the business processes again and again based on the new information available through digitization.

The second lesson learned mentioned above is related to the fact that SAED raised various requests for additional functions during the PoC implementation. It would be the same in a normal system implementation project that priority should be given to mastering the existing functions rather than adding functions that would be better if they were conceived.

In addition to the lessons learned from Maad SAS, JICA survey team observed that this PoC seems to have gone smoothly, but there were some challenges. For example, Maad SAS and the JICA survey team proposed that it would be more effective to concentrate resources in one area with relatively easy access, considering the limited time and budget of the PoC. However, in terms of equity, SAED preferred to distribute tablets to two extension workers in each of the five districts. Next was the issue of which extension and monitoring sheets should be digitized. It was due to the fact that some districts were using their own sheets in addition to the extension and monitoring sheets introduced in PAPRIZ2. In the end, Maad SAS was able to reach an agreement with SAED to digitize the dissemination and monitoring sheets introduced in PAPRIZ2 for two districts, but it took a certain amount of time to make adjustments due to

the differences from the initial assumption. In addition, during the operation training, it was necessary to take measures (such as providing lunch) to motivate the selected extension workers to participate in the training because it was an additional task to their regular duties. This was unexpected by Maad SAS, but with the help of advice from PAPRIZ2 local staff, Maad SAS was able to understand the reality of the situation in advance and responded flexibly. Thanks to such flexibility, this PoC was able to achieve a certain level of success. In addition, JICA has been providing technical assistance to SAED for many years, and the PAPRIZ2 experts were very supportive of this PoC, which was a major factor behind the establishment of the cooperative relationship. Although the theme of this survey is to verify the possibility of using digital technology, the possibility of using digital technology also depends on various aspects other than the technological aspect. This is an important point when utilizing digital technology in any future projects.

3.3.5 PoC implementation (weather forecast)

⑴ Outline of PoC

【Outline of JIRCAS】

The outline of JIRCAS, which was selected as the PoC implementing organization, is as follows

➤ The Japan International Research Center for Agricultural Sciences (JIRCAS) was established in April 2001 as an independent administrative agency from the Tropical Agriculture Research Center (TARC) of the Ministry of Agriculture, Forestry and Fisheries (MAFF), which was reorganized in 1993. In April 2001, it was established as an independent administrative corporation, the International Research Center of Agriculture, Forestry and Fisheries.

➤ Head office: 1-1 Owashi, Tsukuba City, Ibaraki Prefecture

➤ Number of employees: 175 (number of full-time employees in 2019)

【Overview of WeRise】

The following is an overview of WeRise (Weather-rice-nutrient integrated decision support system (www.irri.werise.org)), a solution for weather forecasting and farm management support provided by JIRCAS.

Figure 3-30   Overview of WeRise

Source: Report by JIRCAS

➢ Use case in developing countries: Demonstration tests in rainfed rice cultivation in Indonesia and the Philippines. Localization of WeRise for the central highlands of Madagascar is underway.

【Objectives and KPIs of the PoC】

Considering that the implementation period of the PoC is from February to August 2021, which coincides with the harvesting period of the dry-season crops and the start of the rainy-season crops in the region, the PoC was conducted with the following two objectives;

1. Verification of the prediction of dry-season harvest time and rainy-season planting start time by seasonal forecast

   ✓ Verification of the forecast accuracy of WeRise's seasonal forecast for the same period

   ✓ Verification of the cost reduction effect (optimization of irrigation water volume and irrigation pump usage time) using WeRise seasonal forecast and rice growth model

2. Improvement of agricultural planning using forecast information

   ✓ Verification of the applicability of WeRise for planning to optimize two-season cropping

Based on the above objectives, the following specific KPIs were established.

No	KPIs
1-1	Use of seasonal forecast values for RMSEn<30%* (Evaluation of accuracy of seasonal forecast)
1-2	Set targets for improvement in irrigation water use and fuel costs (Quantitative evaluation of irrigation pump usage time and irrigation water reduction)
2-1	Prediction of harvest time with RMSEn<30% (Test of harvest time prediction)
2-2	Establishment of target groups (Survey on actual conditions of farm management)
2-3	Crop planning for dry-season that allows the necessary number of days from the time of harvest to the completion of repayment (Two-season cropping feasibility assessment)

*Note: Mean square error, an index to evaluate model accuracy, RMSEn<10%: excellent, 10%≤RMSEn<20%: good, 20%≤RMSEn<30%: fair, 30%≤RMSEn: poor

Figure 3-31   KPI for the PoC

Source: Report by JIRCAS

⑵ **Results**

【Implementation method and activities】

The specific outline of the PoC activities is as follows;

➢ Conclusion of contracts with local counterpart organizations for PoC implementation

   • Planning of activities and establishment of implementation team

   • Conclusion of business contract

➢ Development of database for WeRise for the project area

- Preparation of information for seasonal forecast

- Acquisition of long-term meteorological observation data for the project area

- Correction of seasonal forecast data for the target area

- Preparation of soil and crop data

- Preparation of forecast information by WeRise

➢ Identify problems and needs in the project area

- Selection of target farmers

- Preparation of questionnaire and monitoring table (interview items: age, years of farming, gender, cultivated area, variety of rice in use, sowing date, fertilizer application date, harvest date, yield, weight per bag, type of pump, irrigation date, irrigation time)

- Implementation of questionnaires and monitorin, and collection, input and analysis of data (dry season sowing date, harvest date, irrigation water volume, yield)

For the selection of farmers and farmland, 40 plots with independent water management using Sahel 108 varieties and 40 farmers cultivating the plots were selected from the area managed by SAED.

The roles were divided as follows with SAED. During the PoC implementation period, regular meetings were held every Thursday between JIRCAS, SAED, the study team, and PAPRIZ2 experts to check the progress. In the regular meetings, the members of JICA were invited to participate as necessary.

Members of each organization	SAED			JIRCAS
	Khaly Fall (Local coordinator)	Elhadji (technical official)	Kane (technical official)	Hayashi (Coordinator in Japan)
Coordination of the project				✔
Local coordination	✔			
Planning	✔			✔
WeRise Operation Preparation				✔
Preparetion of PoC	✔			✔
Implementation of PoC		✔	✔	
Farmer Monitoring		✔	✔	
Questionnaire and data collection		✔	✔	
Data analysis				✔
Report writing				✔
Regular meetings (every Thursday)	✔	✔	✔	✔

Figure 3-32   Implementing Body and Roles

Source: Report by JIRCAS

【**Achievement of objectives and KPI**】

With regard to the two initial objectives, the following points were demonstrated and confirmed through the PoC. WeRise can be a useful solution in terms of its applicability of seasonal forest in the PoC target area as well as in terms of irrigation water management, and farm planning support to enable efficient double cropping. It can be said that the objectives were achieved.

➢ Objective 1: Verification of the prediction of dry-season harvest time and rainy-season planting start time using seasonal forecast

- Applicability of seasonal forcaset of WeRise in the target area was confirmed by comparison between weather data observed in August in the filed and the average error.

- Regarding water management, the problem of wastage of local irrigation water was confirmed as about 3.9 times more irrigation water is used than the crop requieres.

- By implementing water management practices that take into account the daily water requirement of rice in the dry season cropping and the water supply from expected rainfall by WeRise in the rainy season, the resources (water and cost) for irrigation can be significantly reduced.

➢ Objective 2: Improvement of planning for farming using forecast information

- In the field, it was confirmed that 60% of the farmers harvested their crops too late in the dry season, which may have resulted in a decrease in revenue. It was also suggested that they may have missed the optimal sowing time for rainy season crops due to the late harvest in the dry season.

- By applying WeRise, it is possible to optimize the harvesting time of dry-season crops and the sowing time of rainy-season crops, and it is expected to improve the efficiency of resource use and increase production by improving the planning for farming.

The status of achievement for each KPI is as follows.

KPI1-1: Evaluation of accuracy of seasonal forecast

The average error between the weather data observed in the field in August and the weather forecast data from WeRise was relatively small, which explains the reliability of the forecast information from WeRise to some extent.

- The average error of the observed data and the corrected seasonal forecast values (developed in early June 2021) for August 2021 by the locally installed meteorological instruments are shown in Graph.
- Compared to the results obtained in Southeast Asia, the average error is higher for maximum temperature (Hayashi et al. 2021).
- For rainfall, the average error between the actual and predicted values is relatively small, which explains to some extent the reliability of the predicted information from WeRise (late onset of the rainy season and little rainfall in August).

Meteorological data (August 2021)

Graph: Average error for rainfall, average minimum temperature, average maximum temperature, and average wind speed

Figure 3-33   Achievement of KPI 1-1

Source: Report by JIRCAS

KPI1-2: Set targets for improvement of irrigation water use and fuel cost (Quantitative evaluation of irrigation pump usage time and irrigation water volume reduction)

More than 70% of the target farmers used irrigation pumps of 35 or 88 L/s, and the duration of use was longer in the first half of the cropping season and tended to decrease after the highest cropping season and into the harvesting season.

- Information on irrigation water volume per unit time, power, irrigation duration and irrigation schedule was collected through monitoring of 40 target farmers.
- The irrigation schedule of the farmers in the target area was 14, 28, 42, 56, 70, 84 and 98 days after sowing.
- The pumping rate was found to be different for each farmer, but more than 70% of the farmers were pumping at 35 L/s and 88 L/s (Table).
- The irrigation time was longer in the first half of the cropping season, with the longest time near the highest fruiting stage, and then decreased towards the harvesting stage (Graph)

Table: Amount of water used by pumps in the target area and number of pumps used by farmers

Capacity (L/s)	Number
18	9
35	13
88	16
175	2
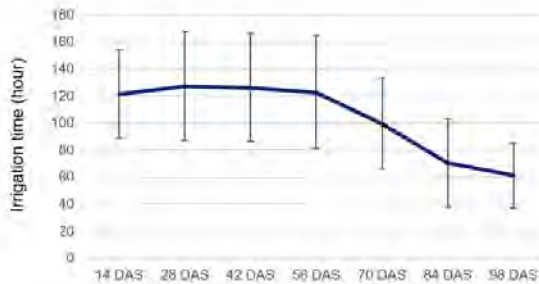
Graph: Trends in irrigation time during the crop season. Vertical bars represent standard deviation

Figure 3-34   Achievement of KPI 1-2 (1/2)

Source: Report by JIRCAS

KPI1-2: Set targets for improvement of irrigation water use and fuel cost (Quantitative evaluation of irrigation pump usage time and irrigation water volume reduction)

The daily irrigation water consumption of farmers in the target area was about 3.9 times higher than the standard value, indicating that farmers were irrigating rice plants more than necessary.

- On the other hand, when the daily irrigation volume was compared, the average irrigation water volume of farmers was 318 kL/ha (±92.6) while the standard value was 82 kL/ha (Graph).
- In other words, the results of the survey showed that farmers' water management used about 3.9 times more irrigation water than the crop water requirement.
- WeRise estimates that the water supply from rainfall during the rainy season is 22.7 kL/ha per day and the daily irrigation during the rainy season is 60 kL/ha.
- If the same water management practices are used as in the dry season, a huge amount of water is expected to remain unused for crops in the rainy season.
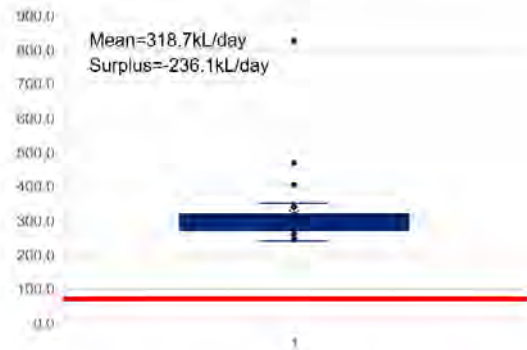
Graph: Daily irrigation volume during the dry season by farmers in the target area. The red line indicates 12.4 ML. The red line indicates the reference value (82 kL)

Figure 3-35   Achievement of KPI 1-2 (2/2)

Source: Report by JIRCAS

KPI2-1 Prediction of harvest timing for dry-season crops

It was found that 60% of the farmers in the target area harvested beyond the standard number of days of ripening.

- The relationship between sowing date and harvest date by farmers in the target area was classified into three groups based on WeRise (130 days of harvest).
- A group which had a shorter growing season and earlier harvest date than WeRise is shown as (<WeRise), the group which had a similar growing season and almost the same harvest date as WeRise is shown as (WeRise=), and another group which had a longer growing season and later harvest date than WeRise is shown as (WeRise<).
- Of the 40 farmers, 3 (8%) were <WeRise, 24 (60%) were WeRise<, and 13 (33%) were WeRise=.

Graph: Relationship between sowing time and harvest time

Figure 3-36   Achievement of KPI 2-1

Source: Report by JIRCAS

KPI2-2 Survey on actual conditions of farm management

Rice farmers in the target area were categorized into four groups: older farmers with low water wastage and high yield (1), older farmers with high water wastage and low yield (2), younger farmers with low water wastage and high yield (3), and younger farmers with high water wastage and low yield (4).

- Water management by farmers (water wastage), dry season crop yield, and age of farmers were used as variables to classify farmers based on principal component analysis and cluster analysis.
- The results of the principal component analysis showed that the first principal component was yield and age (x-axis, negative value = low yield at young age, positive value = high yield at old age), and the second principal component was water wastage (y-axis, negative value = low water wastage, positive value = high water wastage).
- Groups 1 and 2 were older and had more years of rice farming experience, while groups 3 and 4 were relatively younger and had less years of rice farming experience.
- The older and more experienced farmers tended to have higher yields, but the results for water management were very different. The results suggest that factors other than water management determine yield.

Group 4 (Average age: 46.6 years) (Average years of experience: 14.7 years)

Group 2 (Average age: 54.2 years) (Average years of experience: 22.6 years)

Group 3 (Average age: 40.0 years) (Average years of experience: 16.5 years)

Group 1 (Average age: 58.9 years) (Average years of experience: 23.8 ye)
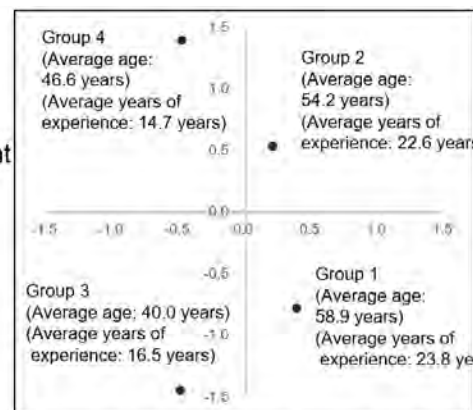
Graph: Distribution of principal component scores for production characteristics of farmers in the target area (x-axis: yield, y-axis: water wastage)

Variable	Case 1	Case 2
Surplus_DS (kL)	0.061	**0.969**
GY(t/ha)	**0.770**	-0.235
AGE	**0.784**	0.155
Cumulative contribution ratio	40.37%	74.29%
+	Increase in yield	Wasted water
−	Decrease in yield	Less wasted water

Table: Production characteristics of farmers in the target area
Main component loadings

Figure 3-37   Achievement of KPI 2-2

Source: Report by JIRCAS

KPI2-3 Dry-season cropping plan that allows the necessary number of days from harvest to completion of repayment (Two-season cropping feasibility assessment)

> According to WeRise's 2021 rainy-season yield forecasts by sowing season, high rainy-season yields are not expected to be achieved unless the harvest is completed by early July, and the loan for dry-season is repaid and preparations for the rainy-season crops are started

- The weather, soil, and crop databases developed for the project site were used to obtain yield projections by sowing timing for the 2021 rainy season crop as of June 2021 (Graph).
- According to WeRise's predictions, after SD1-SD2 (June 27-July 17), yields began to decline and were expected to fall below 3 t/ha after SD4 (July 27-August 5).
- According to the results of the interviews, most of the farmers harvested their crops from mid-July to mid-August, which means that they missed the timing for high yield.
- Since the sowing timing and yield in the rainy-season cropping season were not verified in this study, it is necessary to verify the predicted values with actual measurements in the rainy-season cropping.
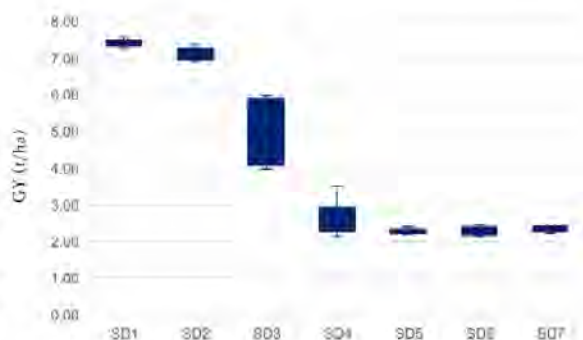
Graph: Timing and yield prediction for rainy season crops
SD1: June 27-July 6; SD2: July 7-July 16; SD3: July 17-July 26; SD4: July 27-August 5; SD5: August 6-August 15; SD6: August 16-August 25; SD7: August 26-August 31. SD5: August 6 - August 15, SD6: August 16 - August 25, SD7: August 26 - August 31

Figure 3-38   Achievement of KPI 2-3

Source: Report by JIRCAS

(3)   Development plan after the PoC

【Future challenges and proposed measures】

Through the PoC, it was confirmed that WeRise is effective for seasonal forecasting and efficient farm management planning in the target areas. In the future, it is an urgent task to improve the accuracy of forecasting and to expand the target varieties and regions in order to complete the Senegalese version of WeRise.

1. Test of WeRise for rainy-season cropping (to verify the accuracy of the prediction of the 2021 rainy-season crop prepared in the PoC)

- Collection of rainy-season crop yield data for 40 target farmers

- Collection of weather data for the 2021 rainy season

- Data analysis and verification of forecast by WeRise

2. Continuation of test of WeRise by SAED (to increase the number of varieties which are popular in Senegal that can be handled by WeRise)

- Build linkages with IRRI's WeRise team

- Real data on soils and crops (physical and chemical properties of typical paddy soils, cultivation data of Sahel108, etc.)

- Long-term daily weather data

3. Multi-site test and wider-area deployment (for practical use of WeRise in the Senegal River basin irrigation area and rainfed area in the South)

- Soil and weather data in the target area

- Preparation of budget and organization for implementation

In addition to the above, it is also necessary to establish a system to collect and input data appropriately and to maintain and operate WeRise continuously, and to disseminate the insights from WeRise for forecasting and farm management planning so that they can be used in the actual field.

【Future development plan】

In a questionnaire survey conducted for SAED after the PoC, JIRCAS and WeRise received very high evaluations (the highest rating on a five-point scale for both partner and solution). As for future development, JIRCAS will continue to provide support to SAED with its own budget, and also continuas support may be provided in the form of ODA as one of the components of PAPRIZ3.

As a concrete proposal for collaboration between JIRCAS's own support and PAPRIZ3, JIRCAS will work from this fiscal year to the next to create a French-language interface, prepare a French-language manual, and support the development and establishment of a database, in order to improve the Senegalese version of WeRise, which was demonstrated in the PoC. In the first year of PAPRIZ3, the work can be done to formulate a plan for future development and to create a system for using WeRise in the field. In the following years, th dissemination of the solution to a wider area can be implemented.
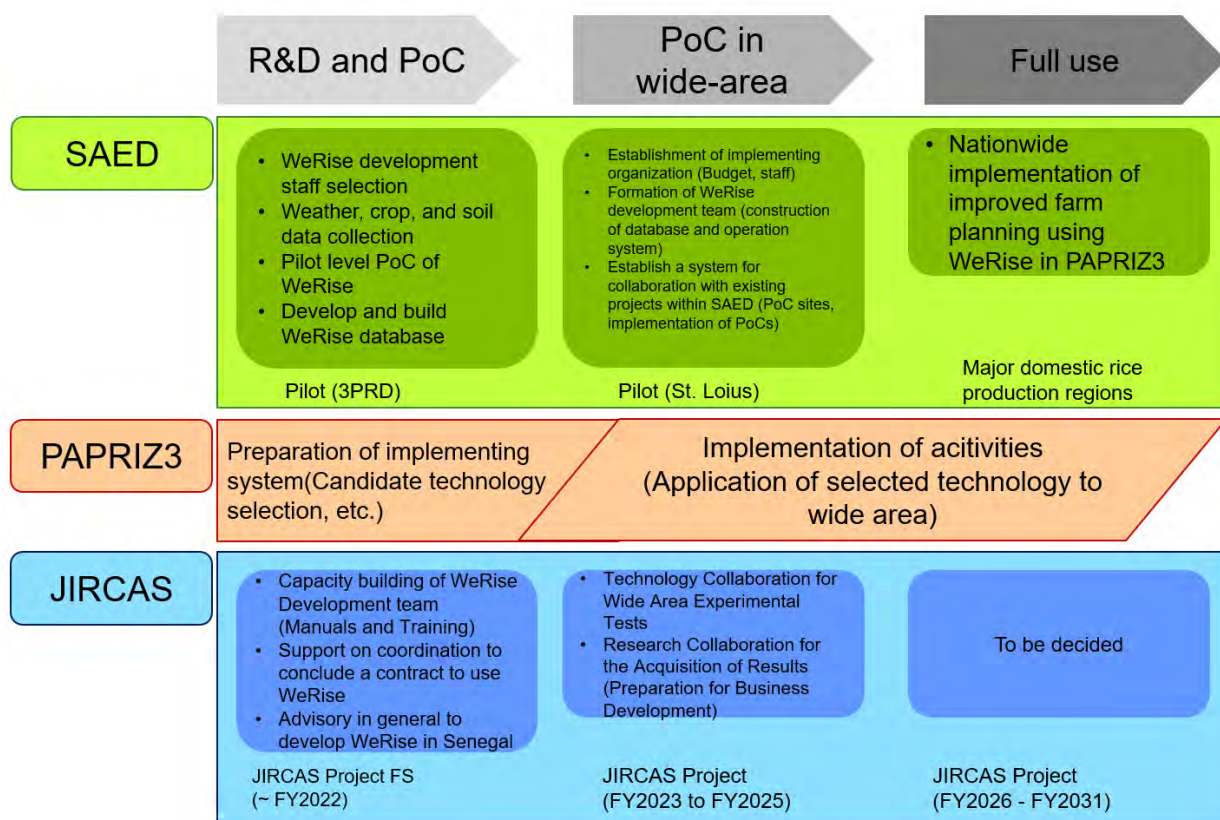
Figure 3-39   Collaobration Image between PAPRIZ3 and JIRCAS's Project

Source: Report by JIRCAS

(4)　Lesson learned and others

【Preparation of PoC】

During the preparation phase of the PoC, some questions were raised by SAED about the positioning and objective of this PoC, such as what the purpose of this PoC is and what will happen next once the results are demonstrated. In order to involve the C/P organizations of the partner country and gain their cooperation, it is important to design the "Exit" of the PoC and clarify the benefits to cooperate. Especially in such situation like this case where neither JIRCAS, the implementing party, or the study team can travel to the site, cooperation of the local C/P organization is essential, and the design of incentives can be the key to the success of the PoC.

Additionally, in order to gain the cooperation of the local C/P organization, it is important to exchange opinions with them from the theme setting stage and to select themes that they truly feel are important challenges. Therefore the theme of this PoC was set after identifying the on-site issues through discussion with PAPRIZ2 experts and exchanging opinions with SAED.

【Operation of PoC】

In terms of operation, SAED was very cooperative, but the schedule was delayed , so it is recommended to make a more relaxed task plan in case of remote implementation. In this context, setting up regular weekly meetings and other regular touchpoints to check the progress of the project was effective in implementing the project remotely.

However, the inability to travel to the site was a major handicap in gaining a deeper understanding of the problems in the field, especially for members of JIRCAS who had never visited the field before. Therefore, if the implementing organizations has no experience travelling to the field and doesn't have a firsthand experience, it is important to provide at least one opportunity to travel to the field in order to ensure the success and continuity of the project.

3.4 Benin

3.4.1 Theme Selection

(1) Background

As a result of discussions with the Department of Africa and the Benin Office of JICA, among the e-government and aquaculture technologies that were candidates themes for the challenge, the e-government was selected, taking into account the fact that e-government is part of the 45 important projects listed in the 2016 – 2021 Government Action Program (PAG) of Benin (6 projects are in ICT sector among PAG) and therefore JICA also has a high interest. Furthermore, as described below, the introduction of e-government require the IT human resources and hardware infrastructure as precondition. In Estonia, which is a leading country in e-government, along with the introduction of e-government services, ICT education have been promoted since the development of IT human resources is an important element for the introduction of e-government. In addition, the Benin government has positioned "Promotion of digital technologies through education and training" as an important project in the aforementioned PAG, and thus decided to set themes related to the development of IT human resources to promote e-government.
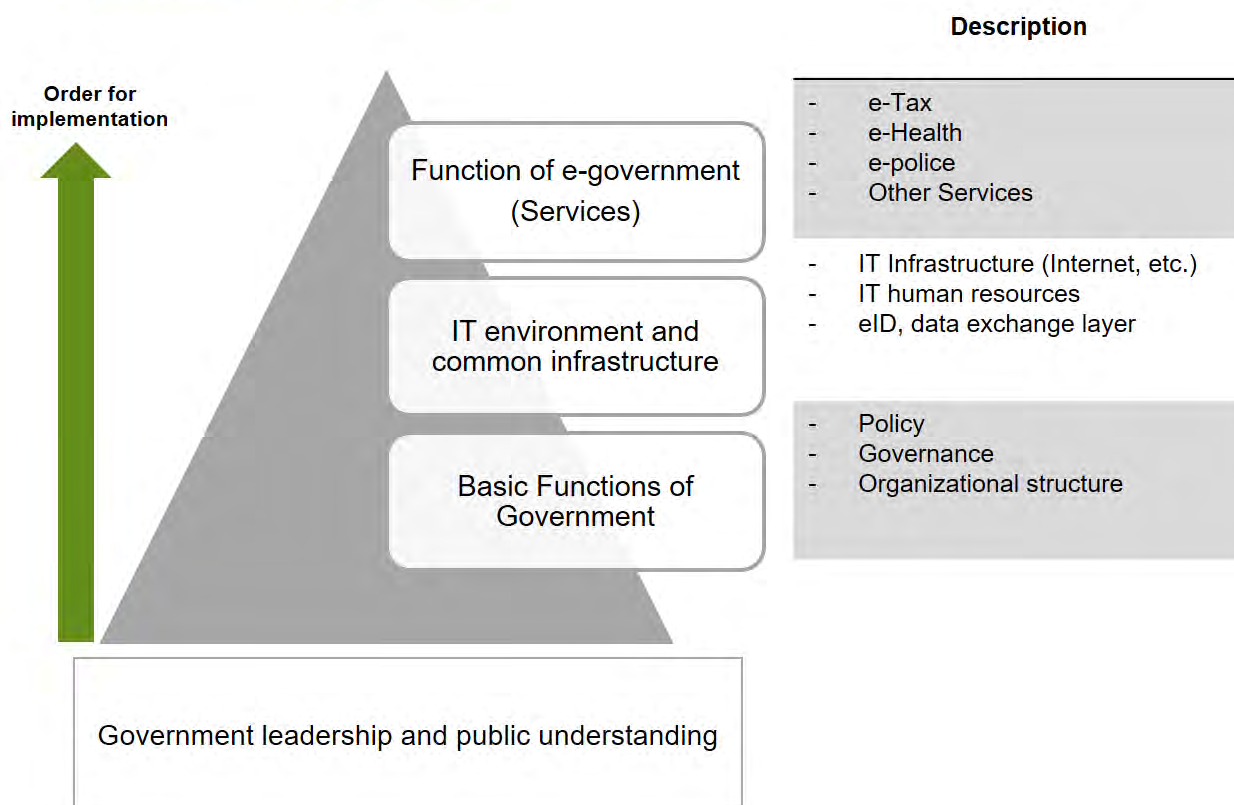
Source: JICA "Research on cooperative measures for e-government projects" Research Report (2007)

Figure 3-40   Conceptual Diagram of Introduction of E-Government

Source: JICA Survey Team
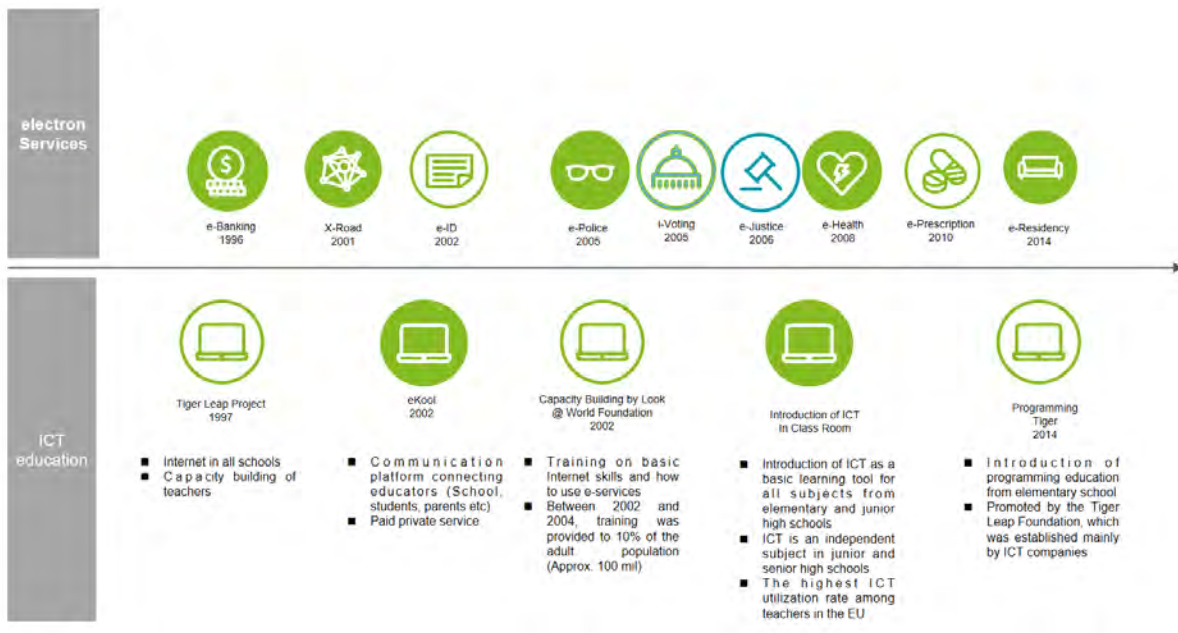
Source: Challenges of the futuristic Estonia, etc.

Figure 3-41   Evolution of E－Government Services and ICT Educati

Source: JICA Survey Team

⑵   Theme Settings

The field study which was originally scheduled in April, 2020 was postponed by the effect of the COVID-19. Therefore, the interviews were conducted with students from Benin staying in Japan regarding local needs, and confirmed there is a high demand for IT human resource development. It was mentioned that though the Benin government has been promoting ICT sector, the IT education in higher educational institutions is too theoritical and the graduates have difficulty to acquire technical skill practical enough to meet requirement from companies, therefore, there is high demand of practical IT training.

In addition, interviews with several Japanese companies were conducted regarding the needs of the participants of the challenge, and confirmed that there were companies interested in developing business in Benin in the field of IT human resource development.

The discussion was held with the Department of Africa and the Benin Office of JICA on how to set up the theme and implement subsequent PoC succesfully in the case of difficulty in travel to the site due to the COVID. The merits and demerits of each theme setting method were summarized as below. In case of conducting a PoC remotely without traveling to the site, it may be difficult to select a local partner to provide a PoC site or to obtain cooperation. Therefore, setting a theme for a collaboration with existing JICA projects or a theme based on solution from a company already operating in the site was considered. However, after considering the merits and demerits of each method, it was concluded to set a theme based on needs in Benin and then call for solutions to meet the needs as originally planed.

	Theme Settings Method	Concrete example	Benefits	Demerits
Option 1	Setting the OI theme by deciding the local partner for the PoC implementation first	Based on the solution of Dive Into Code, an online programming learning service, the theme is set.	■ Partners have been identified during the PoC implementation phase, making it easy to achieve results. ■ Provide incentives to participate in the PoC project because it is feasible even under the COVID	■ Need to target specific companies ■ (If the local company is a potential partner) Difficult to do Due Deligence
Option 2		Based on NEC's solution (Biometrics, etc.), a MOU concluded with the Ministry of Digital, the theme was established.		
Option 3	Setting an OI theme based on needs (conventional method)	Solutions for training IT human resources in Benin.	■ Possible to expect a wide range of solutions.	■ PoC implementation phase may be difficult to achieve due to lack of identified partners ■ Difficulty to draw a specific PoC plan may reduce incentives to participate
Option 4		Missing content for the Seme-City Training Programme (Epitech)	■ Partners have been identified during the PoC implementation phase, making it easy to achieve results.	■ Possible that there is no Japanese stakeholders applying for the challenge
Option 5	Themes are set based on the common awareness and needs of Japanese stakeholders	Provide initiatives to contribute to the Benin ICT sector through cooperation between Japanese stakeholders (to propose solutions as a consortium rather than a competitor)	■ It may encourage cooperation among Japanese stakeholders and create initiatives that cannot be undertaken by a single company.	■ Risk of failing to materialize due to differences in each company's intentions ■ May incur intercompany adjustment costs

Figure 3-42   Comparison of Merits and Demerits of Each Theme Setting Method

Source: JICA Survey Team

In addition, in setting the theme, the efforts of the Government of Benin in relation to the ICT sector in Benin and the state of support from other donors were summarized as follows, and discussions were held on what kind of support JICA should provide. As a result, it was reconfirmed that the development of IT human resources is important not only for the promotion of e-government, but also for the achievement of the Benin government's economic policy goal of becoming a digital service platform in West Africa through the development of the IT industry. And there are a number of companeis interesed in sector from business point of view. Furthermore, at the Japan-Benin Summit Meeting held at TICAD 7 in 2019, President Talon expressed his expectations to the Prime Minister Abe (at that time) for cooperation in the field of education, including vocational training. In light of this, it was decided to focus especially on development of industrial human resources within the IT human resource development.
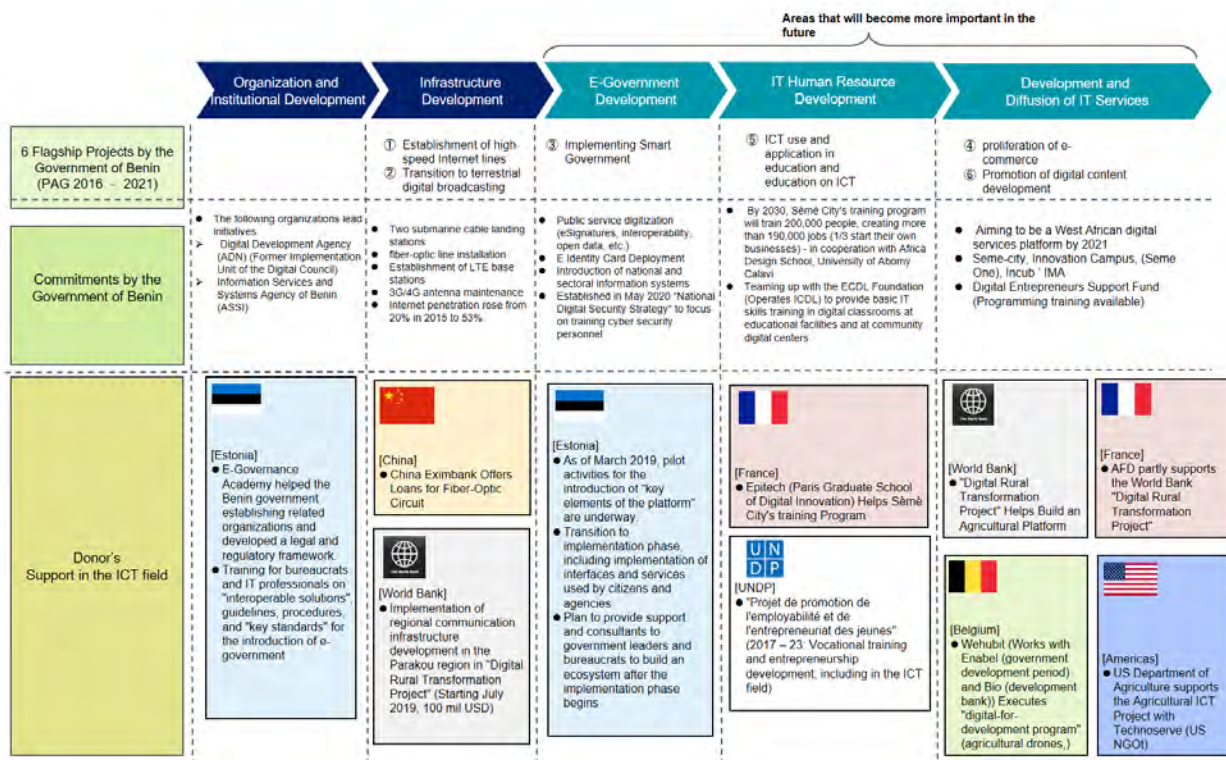
Figure 3-43 (diagram)

Areas that will become more important in the future

| Organization and Institutional Development | Infrastructure Development | E-Government Development | IT Human Resource Development | Development and Diffusion of IT Services |

6 Flagship Projects by the Government of Benin (PAG 2016 - 2021)
- ① Establishment of high-speed Internet lines
- ② Transition to terrestrial digital broadcasting
- ③ Implementing Smart Government
- ⑤ ICT use and application in education and education on ICT
- ④ proliferation of e-commerce
- ⑥ Promotion of digital content development

Commitments by the Government of Benin
- The following organizations lead initiatives
  ➢ Digital Development Agency (ADN) (Former Implementation Unit of the Digital Council)
  ➢ Information Services and Systems Agency of Benin (ASSI)
- Two submarine cable landing stations
- fiber-optic line installation
- Establishment of LTE base stations
- 3G/4G antenna maintenance
- Internet penetration rose from 20% in 2015 to 53%.
- Public service digitization (eSignatures, interoperability, open data, etc.)
- E Identity Card Deployment
- Introduction of national and sectoral information systems
- Established in May 2020 "National Digital Security Strategy" to focus on training cyber security personnel
- By 2030, Sèmè City's training program will train 200,000 people, creating more than 190,000 jobs (1/3 start their own businesses) - in cooperation with Africa Design School, University of Abomy Calavi
- Teaming up with the ECDL Foundation (Operates ICDL) to provide basic IT skills training in digital classrooms at educational facilities and at community digital centers
- Aiming to be a West African digital services platform by 2021
- Seme-city, Innovation Campus, (Seme One), Incub ' IMA
- Digital Entrepreneurs Support Fund (Programming training available)

Donor's Support in the ICT field

[Estonia]
- E-Governance Academy helped the Benin government establishing related organizations and developed a legal and regulatory framework
- Training for bureaucrats and IT professionals on "interoperable solutions", guidelines, procedures, and "key standards" for the introduction of e-government

[China]
- China Eximbank Offers Loans for Fiber-Optic Circuit

[World Bank]
- Implementation of regional communication infrastructure development in the Parakou region in "Digital Rural Transformation Project" (Starting July 2019, 100 mil USD)

[Estonia]
- As of March 2019, pilot activities for the introduction of "key elements of the platform" are underway
- Transition to implementation phase, including implementation of interfaces and services used by citizens and agencies
- Plan to provide support and consultants to government leaders and bureaucrats to build an ecosystem after the implementation phase begins

[France]
- Epitech (Paris Graduate School of Digital Innovation) Helps Sèmè City's training Program

[UNDP]
- "Projet de promotion de l'employabilité et de l'entrepreneuriat des jeunes" (2017 – 23: Vocational training and entrepreneurship development, including in the ICT field)

[World Bank]
- "Digital Rural Transformation Project" Helps Build an Agricultural Platform

[Belgium]
- Wehubit (Works with Enabel (government development period) and Bio (development bank)) Executes "digital-for-development program" (agricultural drones,)

[France]
- AFD partly supports the World Bank "Digital Rural Transformation Project"

[Americas]
- US Department of Agriculture supports the Agricultural ICT Project with Technoserve (US NGOt)

Figure 3-43   Initiatives by the Government of Benin in the ICT field and the Status of Support by Donors

Source: JICA Survey Team

Figure 3-44 (diagram)

Areas that will become more important in the future

| Organization and Institutional Development | Infrastructure Development | E- Government Development | IT Human Resource Development | Development and Diffusion of IT services |

6 Flagship Projects by the Government of Benin (PAG 2016 - 2021)
- ① Establishment of high-speed Internet lines
- ② Transition to terrestrial digital broadcasting
- ③ Implementing Smart Government
- ⑤ ICT use and application in education and education on ICT
- ④ Proliferation of e-commerce
- ⑥ Promotion of digital content development

Commitments by the Government of Benin
- Digital Development Agency (ADN) (Former Implementation Unit of the Digital Council), newly established in 2017
- Information Services and Systems Agency of Benin (ASSI) responsible for security, etc.
- Two submarine cable landing stations
- fiber-optic line installation
- Establishment of LTE base stations
- 3G/4G antenna maintenance
- Internet penetration rose from 20% in 2015 to 53%)
- Public Service Digitization (eSignatures, interoperability, open data, etc.)
- eIdentity Card Deployment
- Introduction of national and sectoral information systems
- Established in May 2020 "national digital security strategy" to focus on training cyber security personnel
- By 2030, Sèmè City's training program will train 200,000 people, creating more than 190,000 jobs (1/3 start their own businesses) - in cooperation with Africa Design School, University of Abomy Calavi
- Teaming up with the ECDL Foundation (Operates ICDL) to provide basic IT skills training in digital classrooms at educational facilities and at community digital centers
- Aiming to be a West African digital services platform by 2021
- Seme-city, Innovation Campus, (Seme One), Incub ' IMA
- Digital Entrepreneurs Support Fund (Programming training available)

Japanese stakeholders Interested in Benin's ICT Sector

[NEC-XON]
- E-Government services, public safety digital solutions, rural infrastructure development, etc.
- MOU with the Ministry of Digital

[Dive into Code]
- Programming education program
- MOU signed with African Samurai Consulting, a local entrepreneur development company

[Kobe University of Information Studies]
- Master of ICT Innovators Course
- MOU concluded with Embassy of Benin in Tokyo

[Castalia]
- Mobile learning platform for programming education
- Available in French

✓ Trained IT human resources will turn into leaders in the development and operation of e-government promotion

✓ Growing IT talent and entrepreneurs are eligible for startup support from other donors

✓ ICT education in Benin emphasizes theory and is not practical. (information obtained through interviews)
✓ Even in Estonia, a leading e-government country, ICT education was being improved at an early stage.
✓ For the development and diffusion of e-government and IT services, highly skilled IT professionals and people with business skills as well as IT engineers are essential
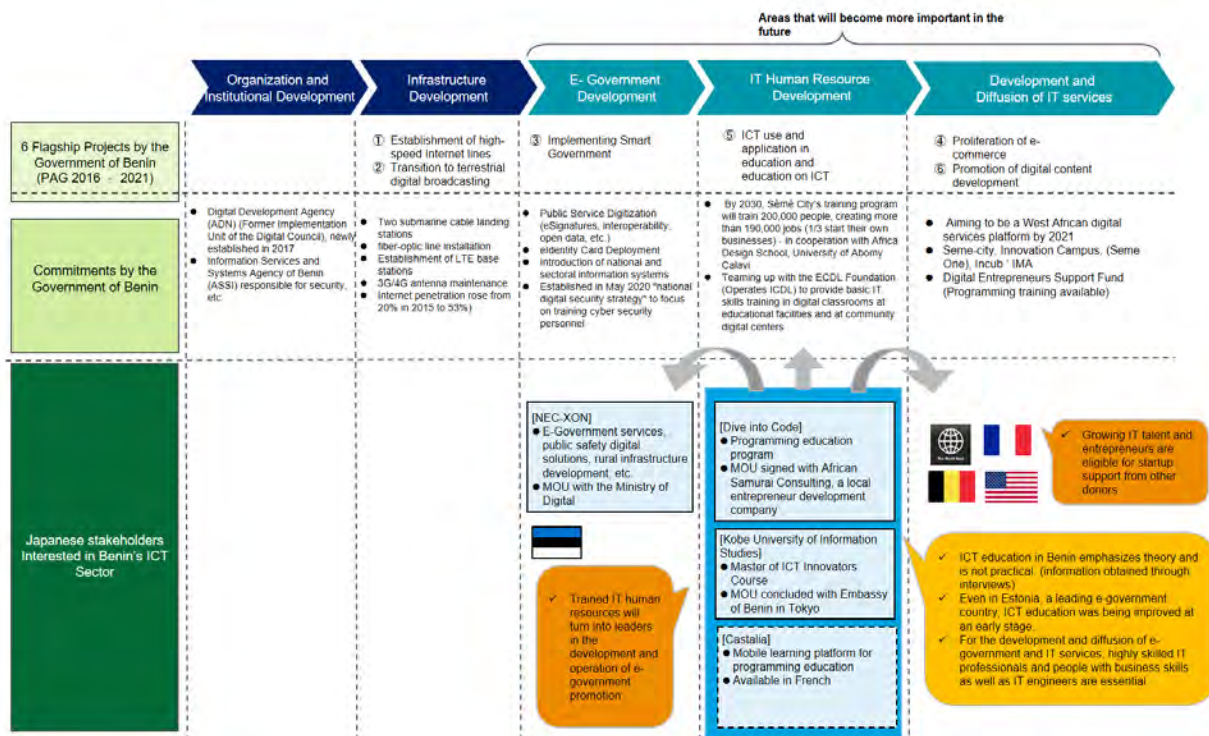
Figure 3-44   Japanese Companies Interested in ICT Field in Benin and Possibility of Future Development of IT Human Resource Development

Source: JICA Survey Team

The outcomes of the discussions were then explained to officials from the Ministry of Digital Economy, the Digital Development Agency (ADN), and the Ministry of Foreign Affairs, which are the main agencies of the Benin government in the ICT field. As a result of the interviews, each organization agreed in principle to the theme setting, and the following areas were indicated as of particular importance in the ICT field, which were reflected in the application guidelines for the Challenge.

■ Development of female engineers

■ Training engineers to promote the game industry

■ Development of cyber security engineers

■ Training App development engineers to promote employment for the youth

■ IT literacy and technical training for government officials

■ Efforts to improve IT literacy for the general public

In addition, discussions were held with the Department of Africa and the Benin Office of JICA on the possible scenarios after the PoC. For the time being, it was decided to pursue two options; forming ODA projects as well as becoming independent business by the private companies.
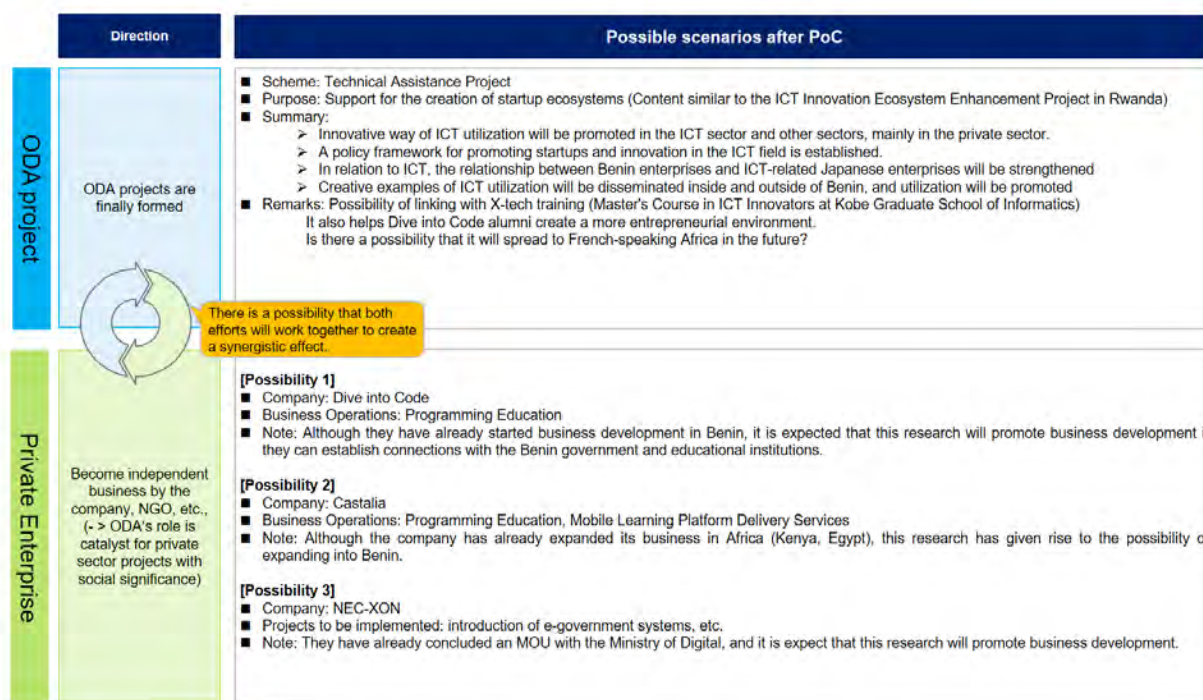
Figure 3-45   Possible Scenarios after PoC

Source: JICA Survey Team

3.4.2   Call for Solutions

A website for public relations and registration was set up for this Challenge. The following is an excerpt from the call for application statements.

In consideration of the fact that a prior survey failed to identify local companies that have solutions for this theme. Besides there is a high possibility that communication and other risks will arise in the case of companies in a third country in consideration of remote PoC implementation, upon discussion with JICA Benin Office it was decided initially that recruitment would target companies in Japan , but based on a request from the Department of Africa of JICA , recruitment pages both in English and French were opened.

CHALLENGE

Innovations to provide the training for IT personnel to promote the digitalization of society

Possible approaches might include, but not limited to: Solutions to provide programming education and other services through remote technology and video

WHAT PARTICIPATE
- JICA will provide Proof of Concept (PoC) opportunity by providing the PoC fund of up to 3~5 million yen
- If the PoC is successful, there are possibilities for technologies/services to be introduced in JICA projects
- JICA will support the PoC by introducing the government agencies and public institutions in the country

POINTS TO CONSIDER
- There are many areas in Benin that have a weak telecommunications environment. Proposals for solutions that can be applied to the weak communication environment are desired.
- As the official language of Benin is French, it is preferable to provide services in French.
- It is recommend that a PoC is implemented in collaboration with the government, local companies and local academic institutions.
- The Government of Benin's focus
- According to preliminary interviews with the government of Benin (Ministry of Digital Economy, Ministry of Foreign Affairs and Digital Development Agency (Agence pour le Développement du numérique)), the government have focused the following areas regarding the ICT human resource development

  ➢ Development of women engineers

  ➢ Training engineers for promoting the game Industry

  ➢ Training engineers in the field of cybersecurity

  ➢ Training application development engineers to promote youth employment

  ➢ Training for government officials in IT literacy and technical skill-up

  ➢ Initiatives to improve IT literacy for the general public

PoC
- It is possible that the government of Benin introduce educational institutions, private companies and industry associations to implement PoC, if necessary.
- In cases travel to the site is difficult due to COVID-19, it is anticipated that the PoC will be conducted remotely

Reference: the Government of Benin's ICT initiatives

The Government of Benin has implemented six flagship projects in the field of ICT in the National Development Plan ((PAG2016-2021), including ICT infrastructure development and e-government development, as well as various other initiatives. ICT Education and ICT utilization in education sector are included in one of the flagship projects.
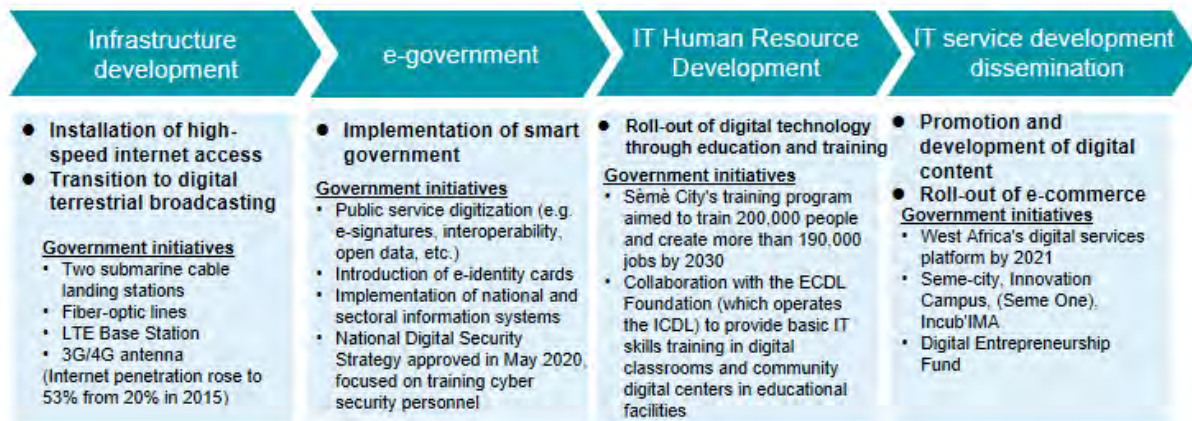
Figure 3-46   ICT initiatives by the Government of Benin

Source: JICA Survey Team

3.4.3   Screening Result

(1)   Applicants

In the end, three Japanese companies applied. The proposed solutions consisted of an online web design cousre and AI engineer training course with OJT opportunities after completion of the course, developing web design learning materials for beginners, and providing remote opportunities to learn basic programming skills that can be used practically, such as work improvement.

(2)   Screening Result

A evalutiaon was conducted in accordance with the criteria described above, and three companies passed the first screening. Then, interviews were held with the aim of deepening the understanding of both the JICA side and the applicant company side, and in particular deepening the understanding of the on-site needs and conditions by the applicant company side, so that the solution and demonstration plan can be refined for the final screening.

As a result of the final screening, DIVE INTO CODE Co., Ltd. was selected based on the fact that the company has already started the development of local human resources with concluding a Memorandum of Cooperation (MOU) with the local company, and the proposal covers not only human resource development but also the provision of employment opportunities. After the first screening, the interview was held with head of AND Mr. Serge Adjovi for his comments, and it was confirmed that DIVE INTO CODE was their priority, which coincided with the result of final screening.

The judges for the screening were as follows (△ is the role of confirming the draft of the screening results).

3.4.4　Implementation of the PoC

(1)　Overview of the PoC

DIVE INTO CODE has decided to provide online programming education (3 months of web engineering course focusing on Ruby) and internship (1 month) for free to 24 people in Benin, which DIVE INTO CODE has been providing in Japan and Rwanda. In order to examine the extent to which it can contribute to solving social issues in Benin through its entry into the market, the following activities and KPIs were set with the aim of verifying the company's business model. The KPI were decided a litte bit lower than Japanese students in consideration of DIVE INTO CODE's experience in Japan and Rwand as well as the Benin local environment like internet connection.

Table 3-8　PoC activities and KPIs

Activity		KPI
Activity 1	24 students in Benin were provided with opportunities to learn programming in French using the online learning platform named "DIVER".	Graduation rate 60%
Activity 2	As a culmination of the programming study, a presentation of the graduation project will be held in a collaboration with local and Japanese government agencies and companies.	Holding a presentation of the graduation project
Activity 3	The program provides employment opportunities for the graduates, including in-house employment as educational mentors and IT engineers, employment by local IT companies, independence as entrepreneurs, and employment as freelance IT engineers.	10% find jobs within a month and 30% within 6 months of graduation

Source: JICA Survey Team

This PoC was not carried out in collaboration with the existing JICA technical cooperation project, but by building relationships with the Benin government officials through this survey. Specifically, JICA suvery team asked ADN, which had cooperated from the proposal setting and screening stages, to participate in the regular weekly meetings (with the participation of DIVE INTO CODE, its local partner company Africa Samurai Consulting, ADN, JICA Benin office, and the JICA survey team), and conducted PoC while constantly sharing information.

(2)　Results

Africa Samurai Consulting, which has connections in the IT industry in the region, took the lead in recruiting students through SNS and other means. As a result, 1,735 applications were received in one month, demonstrating the high demand for IT education in Benin. A total of 24 students were selected through the following procedure.

➢ **Step1**：Examination and document screening

- ・ 53 candidates passed the examination, and their motivation (reason of the application) were evaluatetd by four rating.

➢ **Step2**：Online Interview

- ・ Candidates were asked the following questions and their answers were evaluated.

  ①　Self-introduction

  ②　Why do you apply for this program?

③   When are you available (for study)?

④   How can you manage your time enough to complet this program requiring 8 hours study per day?

⑤   What is your dream after acquiring skill and knowledge through this program?

⑥   What is your weakness point?

➢ **Step3**：Final Screening

・   After the interview, revieing each candidate according to the following criteria and decide 24 applicants in consideration of their document and result of the interview.

①   Motivation and future vision: 30%

②   Result of the examination: 40%

③   Level of commitment enough to complete the continous full-time study for 4 months: 30%

④   Career plan after the graduation: 10%

The results of the implementation of each activity and KPI are shown below, with all activities exceeding their KPIs.

Table 3-9   Results of PoC implementation

Activity	KPI	Results
Activity 1	Graduation rate 60%	19 out of 24 students graduated from the web engineering course (79% graduation rage)
Activity 2	Holding a presentation of the graduation project	Graduation project presentations and closing ceremony were held online, and original applications developed by graduates were presented (demonstrations will be given).
Activity 3	10% find jobs within a month and 30% within 6 months of graduation	17 students did internships at IT companies after graduation, and 6 students found jobs at IT companies within a month (25% employment rate)

Source: JICA Survey Team
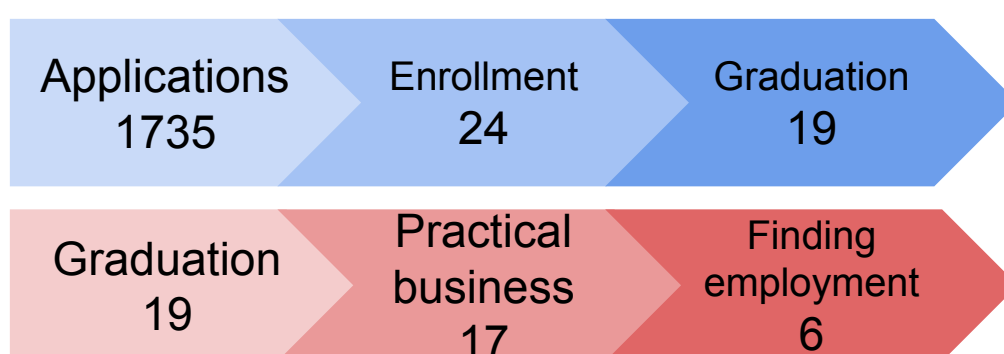
Figure 3-47   Results of PoC Implementation

Source: Report by DIVE INTO CODE

Before the start of the programming course, an opening ceremony (online) was held with the participation of JICA and ADN to motivate the students, and mentors frequently followed up with the students during the implementation of the programming course to prevent them from dropping out. This was done multiple

times in response to the needs of the students. In addition, with the cooperation of the Agence Nationale Pour l'Emploi (ANPE), ANPE was able to conduct job placement workshops for the students.

As for the internship program, through Africa Samurai Consulting's connections and approaches to organizations introduced by ADN, internship sites were secured (13 domestic and international companies including local IT companies) and the internship opportunities were provided to 17 students, and 6 of them got jobs opportunities. There are several reasons why they got the job opportunities. Firstly, they were able to demonstrate their high level of programming skills to the company by demonstrating the original application that they developed as the graduation project. Secondly, they were evaluated by their positive attitude toward learning new technologies and their ability to solve problems by tackling tasks that assumed practical work in the web engineering course. Thirdly, the internship gave them an opportunity to show their actual skills.

These 6 graduates who obtained jobs are currently engaged in web application development, website creation, and e-learning system development, and most of them are using Ruby, JavaScript, and Vue.js, which they learned in the web egineering course, as their main development languages. Most of tem use Ruby, JavaScript, and Vue.js, which they learned in the web engineering course, as their main development languages while one of them is learning PHP/Laravel, which are related languages for web application development.

Table 3-10   Lists of Internship Destinations and Employers

List of Internship Destinations

Company name	Location	Industry type
IWAJU Tech	Benin	IT
MA INFO	Benin	IT
ETRI Lab	Benin	IT
Benin FinTech	Benin	IT
Benin Digital	Benin	IT
OpenSI	Benin	IT
Abuzweb	Benin	IT
Epitech	Benin	Education
Leadd SARL	Benin	IT & research
Croix Rouge Benin	Benin	Medical care
ENABEL	Benin	Government of Belgium Development Aid
KeyTech	Côte d'Ivoire	IT
Charles Technology Africa	Ghana	IT

List of Employers

Company name	Location	Industry type
IWAJU Tech	Benin	IT
Benin Digital	Benin	IT
Leadd SARL	Benin	IT & research
KeyTech	Côte d'Ivoire	IT
Visual Design Cafe	Netherlands	IT
X-AFS	United States	IT

Source: Report by DIVE INTO CODE

From these results, it can be said that the IT education course provided by DIVE INTO CODE is in high demand in the local market and has a high possibility of contributing to the spread of IT education and the provision of job opportunities, which are social issues in Benin. However, because this PoC was free of charge, more than 1,700 people applied, and several students already had certain programming skills and work experience. Further verification is needed to make a judgment on the demand for Ruby as a programming language and whether learning programming from scratch will lead to practical leve enough to get a job.

(3)   **Post-implementation deployment plan**

As mentioned above, it is proved that there is sigunificat need for the IT education course by DIVE INTO CODE as it was assumed before the PoC, two members of DIVE INTO CODE traveled to Benin for about a week from late November to consider the detail business plan though discussions with Benin government

agencies, universities, and private companies. Then, they were able to exchange positive opinions on building collaborative relationships with each organization for future business development.

Table 3-11   Consulted parties in the field survey

Name	Industry	Category
ANPE (National Agency for Promotion of Employment)	Employment Promotion	Government Agency
Leadd SARL	System Development/Reserch	Private Company
IWAJU Tech	System Development	Private Company
MA INFO	System Development	Private Company
IFRI (Institute of IT Training and Research)	IT Training	University
CIO Magazine	IT Media	Private Company
ADEJ (Agency for Development of Youth Entrepreneurship)	Support for Youth Entrepreneurship	Government Agency
EPAC (Polytechnic School of Abomey-Calavi)	Vocational Training	University
PSIE (Special Employment Integration Program)	Employment Promotion	Government Agency
MPMEPE (Ministry of SMEs and Employment Promotion)	SMEs Support and Employment Promotion	Central Government
ADN (Agency for Digital Development)	Digital Development	Government Agency
ANPME (National Agency for SMEs)	SMEs Support	Government Agency
MDAD (Ministry of Digital Affairs and Digitization)	Digital Development	Central Government

Source:Report by DIVE INTO CODE

The PoC revealed that there is a high need for programming education in Benin, and since local government agencies have designated it as one of their priority areas, the possibility of collaboration with local government agencies is relatively high. In addition, since DIVE INTO CODE's local partner company is building relationships with local government agencies and local IT companies, Benin can be considered as a market with high business potential for DIVE INTO CODE. In fact, after the PoC was completed, the web engineer course was started in January 2022 for a fee ($1200/4 months), and 10 people have taken the course.

In the future, DIVE INTO CODE will aim to form an ecosystem of IT human resource development, employment, and entrepreneurship, in which local government agencies, industry, government, and academia work together, and also prepare to offer new courses that will enable more diverse IT human resource development at a lower cost. Especifically, the following initiatives are planned.

➢ DIVE INTO CODE tries to strengthern the relationship with the local government (ADN, ANPE, ADEJ), companies, and universities in order to launch a government-lead project to form the ecosystem from IT human resource development to employment and entrepreneurship. For example, ADN operates a vocational training school that provides IT education, so it will explore the possibility of providing curriculum to the school. It will further strengthen the cooperation with ANPE, which cooperated in the PoC by holding seminars on job hunting, etc., by considering the use of ANPE's platform and subsidies for companies to support matching the graduates with local IT companies. It also plans to collaborate with ADEJ to establish a cooperative system to provide entrepreneurship training and funding support to the graduates so that they can start their own businesses based on the applications developed in the course.

➢ In addition to the web application development courses, we are also preparing to offer courses in the field of machine learning, which the local government and universities are focusing on, as well as developing courses for learning other programming languages such as Java and PHP.

> In addition to the full-time course, which costs 150,000 yen for four months, preparations are underway to offer a low-cost course that will allow students to study the same content for about 5,000 yen per month.

(4)　Lessons Learned and Others

JICA has not implemented any technical cooperation projects in the field of IT in Benin, and the challenge was to find an opportunity to build a relationship with the Benin government. The JICA Benin office supported JICA survey team and DIVE INTO CODE to connect ADN, and the DIVE INTO CODE was able to have a good relationship with ADN. Although there were some concerns about the continuation of the relationship with the ADN President, as he retired just before the PoC, ADN was very supportive to this PoC. It may be due to the fact that JICA survey team consulted and reported to the ADN in both the proposal setting and proposal screening stages. In this way, by involving the partner country organizations from the proposal setting and screening stages, it is possible to obtain their active cooperation in the implementation of the PoC, such as introducing relevant government organizations (ANPE, etc.) and participating in the opening and closing ceremonies.

In addition, one of DIVE INTO CODE's expectations for this PoC was to build relationships with government agencies in Benin. It can be said that this PoC is a good example of how a private company is able to build good relationships with government agencies that would be difficult to approach in the normal course of business by participating in the JICA's activity. On the other hand, although the company was able to build good relationships with ADN and ANPE, it does not expect to formulate ODA projects (use of the company's services in ODA projects) after this PoC according to its policy "solving social issues through business". In this way, there are cases where the purpose of collaboration with JICA is not use of their solutions in ODA projects but to build relationships with government agencies in the partner country. One of the lessons learned from this PoC is that matching between what companies expect from JICA and what JICA (especially JICA field offices) can provide is important, in addition to matching between development issues and relevant solutions.

3.5   Tanzania

3.5.1   Theme Setting

As discussed in Chapter 2, Tanzania considered three areas: improving the efficiency of irrigated agriculture, improving the efficiency of agriculture, and improving the efficiency of training for Taxation personnel. After that, based on the results of the consultation with the Tanzania Office, the team focused on agriculture and financial inclusion and examined the issue setting. Due to the spread of the new coronavirus infection, the field survey, originally scheduled for March 2020, was postponed and then cancelled. From June to August 2020, questionnaire surveys and remote interviews were conducted with JICA project experts, government agencies, donors, local incubators, educational institutions, banks, etc., related to the agricultural field.

Questionnaire surveys and interviews were conducted by the following organizations. OI themes were examined based on the information of the companies that conducted OI theme-related questionnaire surveys and interviews, and the companies that conducted STI theme-related questionnaire surveys were asked to cooperate in informing the companies in their network when the call for proposals were open.

Table 3-12   Parties conducting questionnaire surveys and hearings (Tanzania: OI Theme Relations)

#	Category	Survey Location	method of implementation
1	JICA Project (Agriculture)	"PROJECT FOR STRENGTHENING DADP PLANNING AND IMPLEMENTATION CAPACITY THROUGH USE OF SHEP APPROACH (TANSHEP)s" Expert (IDCJ, NK)	Interview
2	Government (Agriculture)	Ministry of Water and Irrigation	Questionnaire
3	Government (Agriculture)	Tanzania Agricultural Development Bank (TADB)	Questionnaire
4	Government (Agriculture)	Ministry of Agriculture (TANSHEP)	Questionnaire + Interview
5	Government (Agriculture)	Ministry of Agriculture (M & E)	Questionnaire + Interview
6	Government (innovation)	Tanzania Commission for Science and Technology (COSTECH)	Questionnaire
7	Government (financial inclusion)	Ministry of Finance and Planning	Questionnaire
8	Donor (Agriculture)	WFP Innovation Hub	Questionnaire
9	Donor (financial inclusion)	UNCDF	Questionnaire
10	Donor (agricultural and financial inclusion)	UNDP	Questionnaire
11	Association (Agriculture)	Tanzania Horticultural Association (TAHA)	Questionnaire
12	a nonprofit organization (NPO)	Private Agricultural Sector Support Trust (PASS)	Questionnaire

Source: JICA Survey Team

Table 3-13   Recipients of questionnaire surveys (Tanzania: STI relations)

#	Category	Survey Location	method of implementation
1	MNO	Vodacom	Questionnaire
2	MNO	Tigo	Questionnaire
3	Incubator/Accelerator	Anza Hubs	Questionnaire
4	Incubator/Accelerator	STIClab	Questionnaire
5	Incubator/Accelerator	Twend Social Innovation Center (Twende Hub)	Questionnaire
6	Incubator/Accelerator	TANZICT (Bunihub)	Questionnaire
7	Incubator/Accelerator	Sahara Ventures/E-KILIMO	Questionnaire
8	Incubator/Accelerator	Jematech	Questionnaire
9	Incubator/Accelerator	Ennovate Hub	Questionnaire
10	Incubator/Accelerator	Hub 255	Questionnaire
11	Incubator/Accelerator	Ndoto-Hub	Questionnaire
12	University	Ardhi University	Questionnaire
13	Bank	Vision Fund Tanzania Microfinance Bank Ltd.	Questionnaire
14	Bank	Yetu Microfinance Bank	Questionnaire

Source: JICA Survey Team

The outline of the survey results is as follows. The issues were categorized by themes, and the possibility of OI implementation was examined for each OI theme candidate.

Table 3-14   OI Theme Option Grouping (Tanzania: Agriculture)

	Themes	Opinion on the Issues	Source
1	Lack of financial access	✓ Farmers cannot access to microcredit for inputs ✓ It is difficult to extend loans to horticulture groups because they are not legal groups such as private companies or agricultural cooperatives.	JICA Expert (TANSHEP)
		✓ Many financial institutions do not extend loans to small farmers. Collateral and high interest rates are hurdles.	MoA (TANSHEP)
		✓ Lack of funds to invest in irrigation	NIRC
		✓ Access to financial services — due to lack of legal credentials such as education, low technology, high barriers to financial services, and national identity	WFP
2	Difficulty in real-time monitoring and data collection	✓ Standard formats are distributed and manually collected monthly, quarterly, and yearly by extension personnel ✓ It is necessary to know the number of farms and equipment in the area where the extension workers are in charge, but the real-time monitoring is difficult. ✓ Limited sampling of information from farmers (Maze, etc.) ✓ The "quality" of the data is poor, and data that does not reflect the actual situation.	MoA (M&E)
3	Lack of electronic data management	✓ Market research conducted by farmers is conducted on a paper basis, and project staff manually input information into Excel. ✓ Many farmers collect data on price trends manually. It would be better to establish a system where many people can type in.	JICA Expert (TANSHEP)
		✓ Farmers use paper data, and they struggle to ensure the quality and cost of information.	MoA (M&E)
4	Pest damage	✓ It is convenient to have an AI application for disease diagnosis because the damage of pests is substantial. Tomato suffers great damage when grown in the rainy season. Tomatoes and onions are particularly susceptible to the rainy season.	JICA Expert (TANSHEP)

Source: JICA Survey Team

Table 3-15   OI Theme Option Review (Tanzania: Agriculture)

#	OI Theme Candidates (Local partner candidates in parentheses)	Source	Points of OI feasibility study					Points of Attention
			Relations with OI	Feasibility under COVID-19	Appeal to applicants	External factor	Opinion from Agriculture Expert	
1	Solutions for Improving Financial Access in Rural Areas (Partner Candidate: TBD)	JICA experts (TANSHEP), MoA (TANSHEP), NIRC, WFP	○ A variety of methods can be considered	△ Technically possible, but requires a partner	○ There are a certain number of players in the target area.	△ Difficulty of financial regulations, depending on the content	–	Interviews have shown that compliance with Tanzanian financial regulations and laws is necessary and that barriers to entry for foreign firms are high
2	Solutions for real-time monitoring and agricultural data collection (Partner Candidate: TANSHEP/MoA)	MoA (M & E)	△ Existing system	△ It is possible if the partner is confirmed.	○ There are a certain number of players in the target area.	○ Nothing in particular.	○ "Vasic information gathering" "Support for dissemination activities"	Since the system already exists, capacity enhancement of the input person (Ministry of Agriculture staff) and devices may be the issues.
3	Solutions for digitizing paper-based data (Partner Candidate: TANSHEP)	JICA Expert (TANSHEP)	○ Use of AI-OCR technology	○ Confirmation of cooperation with TANSHEP	○ There are a certain number of players in the target area.	○ Nothing in particular.	○ Similar content at the meeting	Input (data format to be read) and output (output format) that need to be used must be confirmed.
4	Solutions that contribute to the collection and sharing of agricultural prices (Partner Candidate: TANSHEP)	JICA Expert (TANSHEP)	○ A variety of methods can be considered	○ Confirmation of cooperation with TANSHEP	○ There are a certain number of players in the target area.	○ Nothing in particular.	○ "Sharing information among farmers"	Expanding the range of applicable technologies is necessary by including methods and incentives for obtaining agricultural product prices
5	Solutions for crop pest diagnosis (Partner Candidate: TANSHEP)	JICA Expert (TANSHEP)	○ A variety of methods can be considered	△ It is possible if the partner is confirmed.	○ There are a certain number of players in the target area.	△ Farmers' smartphone ownership rate is low	○ "Judgment of the development status"	There are existing tools such as Plantwise

Source: JICA Survey Team

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Table 3-16   OI Theme Option Grouping (Tanzania: Financial Inclusion)

	Themes	Opinion on the Issues	Source
1	Financial institutions cannot accommodate small loans	✓ Farmers cannot access to microcredit for inputs ✓ It is difficult to provide loans to horticulture groups because they are not legal groups like private companies or JA.	JICA Expert (TANSHEP)
		✓ Many financial institutions do not extend loans to small farmers. Collateral and high interest rates are hurdles	MoA (TANSHEP)
		✓ Financial institutions have high interest rates for financial services	WFP
2	Poor financial literacy in rural areas	✓ SMS may also fail due to low literacy rates (Especially women.). Therefore, there is a need to provide services through voice rather than through ordinary services. ✓ Limited education levels	YETU MICROFINANCE BANK PLC
		✓ Limited education levels	WFP
3	Lack of infrastructure to provide financial services	✓ Rural mobile networks are limited to HALLOWTEL, and TIGO and M-Pesa, which utilize a lot of mobile money, cannot be utilized ✓ Lack in hard infrastructure	YETU MICROFINANCE BANK PLC
		✓ Lack of low technology, national identity, and other legal certificates	WFP

Source: JICA Survey Team

Table 3-17   OI Theme Option review (Tanzania: Financial Inclusion)

	OI Theme Candidates (Local partner candidates in parentheses)	Source	Points of OI feasibility study				Points of Attention
			Relations with OI	Feasibility under COVID-19	Appeal to applicants	External factor	
1	Small-Scale Financing Solutions for Farmers (Partner Candidate: TBD)	JICA Expert (TANSHEP), MoA (TANSHEP), WFP	○ A variety of methods can be considered	△ Technically possible, but requires a partner	○ There are a certain number of players in the target area.	△ financial regulations, depending on the content	AI credit scoring, etc. can be applied
2	Solutions for Improving Financial Literacy in Rural Areas (Partner Candidate: TBD)	YETU MICROFINANCE BANK PLC, WFP	○ A variety of methods can be considered	△ Technically possible, but requires a partner	○ There are a certain number of players in the target area.	△ financial regulations, depending on the content	YETU MICROFINANCE BANK PLC has developed community radio programs. Communication with farmers through voice
3	Solutions that contribute to the provision of financial services even with weak infrastructure (Partner Candidate: TBD)	YETU MICROFINANCE BANK PLC, WFP	○ A variety of methods can be considered	△ Technically possible, but requires a partner	○ There are a certain number of players in the target area.	△ financial regulations, depending on the content	YETU MICROFINANCE BANK PLC opens remote accounts that can be used in remote areas.

Source: JICA Survey Team

As a result of the analysis of OI theme options in the field of agriculture in Tanzania, we have selected to collect solutions that contribute to the visualization of market information collected by the existing technical cooperation project TANSHEP and the efficiency of information collection. Specifically, "A solution that enables smallholder farmers to collect and share information on local agricultural markets by planting crops at market prices to increase their income." and "A solution that makes it possible to instantly and easily digitize and share hand-written information (Market information, etc.) that is difficult to share and is easily lost." were selected as candidates. As a result of the analysis, on the assumption that market information of both sides can be aggregated and information can be shared between farmers by combining the 2 solutions, "Innovation to support marketing by extension workers and farmers to enhance the effectiveness of the SHEP (market-oriented agriculture) approach" and was decided by making it an OI theme.

With regard to financial inclusion, a wide range of themes were selected in light of the severe needs in Tanzania. "Small-Scale Financing Solutions for Farmers", "Solutions for improving financial literacy in rural areas", and "Solutions that contribute to the provision of financial services even in fragile infrastructure" were selected as the OI themes, and the team has finally combined 3 themes "Innovation to

Facilitate Improved Financial Access for Small- and Medium-Sized Micro-enterprises Engaged in Rural Farmers/Farming and Processing".

3.5.2 Call for Solutions

A request for proposals website was set up for this event. The following is an excerpt from the call for solutions.

(1) Agricultural Sector

<u>CHALLENGE</u>

Solution to Support Marketing Activities for Agricultural Extension Officers and Farmers

 (Examples of possible solutions)

- A solution to allow agricultural workers (agricultural extension officers, farmers), using their own tablet computers and mobile phones, to obtain and accumulate market information, and share it with other agricultural workers who need it

- MA (marketing automation) and CRM (customer relationship management) tools for agricultural workers to use in their marketing activities

- A solution to generate data from market information that farmers are currently keeping in a paper form

<u>BACKGROUND</u>

In Tanzania, JICA is undertaking the Project for Strengthening DADP Planning and Implementation Capacity through Use of SHEP Approach (TANSHEP; discussed below), with an aim to help increase the income of horticultural farmers by changing the mindset of fruit and vegetable farmers, from "grow and sell" to "grow to sell," and improving their skills in agricultural management and farming.

With the SHEP approach, it has been demonstrated that encouraging farmers to collect and share information in an active and assertive manner is an effective way of helping the farmers take the initiative in keeping themselves motivated. However, a challenge is that only a few farmers have had an experience of conducting market research. If they would be able to share the results of their market research, actual sales results, and other information within their farmers' group or with other farmers' groups in the neighboring areas, it may create advantages, helping them recognize market opportunities in their neighboring regions and selling their crops as a group.

The team is particularly seeking for approaches that will help local agricultural workers who have familiarized themselves with the after-mentioned Smallholder Horticulture Empowerment and Promotion (SHEP) approach to gather and accumulate information (varieties of crops and their quantities, quality, etc. that are in demand) as it is acquired through market research, and share it within/between farmers' groups. Thus, the solution should be intended to promote a change in the farming mindset to "grow to sell," and increasing income levels for agricultural workers.

If the technology is established following the verification testing, it may potentially be applied to other agricultural support SHEP approach-related projects that JICA is undertaking in other countries.

<u>What is Smallholder Horticulture Empowerment and Promotion (SHEP) Approach?</u>

Smallholder Horticulture Empowerment & Promotion (SHEP) Approach have developed in Kenya through technical cooperation project by JICA which started from 2006 and succeeded in increasing farmers' income. SHEP is an approach which realizes "Market-Oriented Agriculture" and converts farmers mind from "grow and sell" to "grow to sell". In Kenya, with this approach, the project achieved doubling income of 2,500 smallholders only within 2 years (2007-2009).

JICA has set the wide implementation of the SHEP Approach to countries throughout Africa as one of the pillars of Agricultural cooperation in Africa. In this page you will see how SHEP has been expanding.

For further details： https://www.jica.go.jp/activities/issues/agricul/approach/shep/index.html
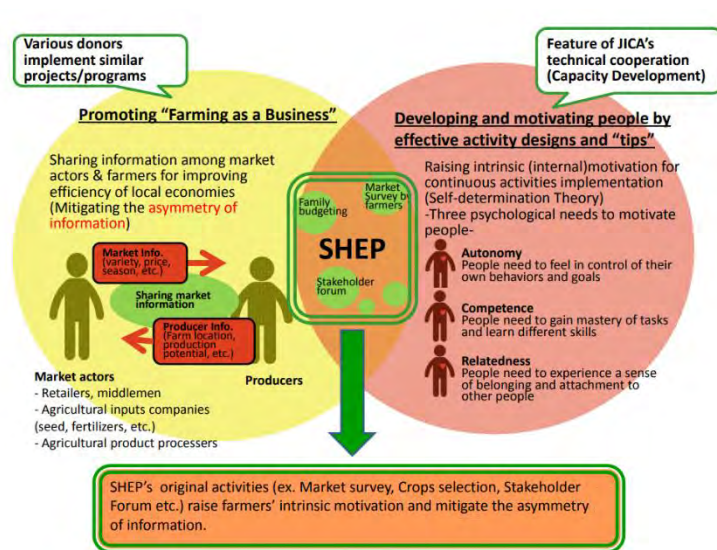
Figure 3-48   Concept of SHEP Approach

Source: JICA (https://www.jica.go.jp/activities/issues/agricul/approach/shep/index.html)

WHY PARTICIPATE

- JICA will provide PoC opportunity (Users are expected to be agricultural extension officers and farmer groups) JICA will provide Proof of Concept (PoC) opportunity by providing the PoC fund of up to 3~5 million yen

- If the PoC is successful, there are possibilities for technologies/services to be introduced in JICA projects

- JICA will support the PoC by introducing the government agencies and public institutions in the country

POINTS TO CONSIDER

- 4G network is available, especially in the metropolitan areas; however, connectivity is poor in a number of areas, and it is desirable that a proposed solution should be applicable in such areas

- There are several preexisting market information services by private companies in Africa. The solution that this RFP calls for is as listed below:

Table 3-18 Relationship between the solution required by this challenge, general market information services, and current SHEP approach

Service	Information	Method of collecting information	Method of delivering information	Notes
Basic market information service	Market price per market, buyer or middlemen information and others	Agents visit markets and collect information	Uses messages using USSD and SMS	Users with mobile phones can access (however, users must deliberately access the information) Price information are limited to large market's wholesales price. Information is not frequently updated due to agent's limited mobility
Current SHEP approach	Market research: collects information on contacts, market location, market price from wholesalers, middlemen and others. Actual selling price	Farmer conducts market research and input data in a paper format Actual selling price is researched through agricultural extension officers to farmers. The results of above research in inputted into excel sheet and analyzed by local government officers.	A delegate from a famers group shares information of the market research paper form to other members If necessary, local government introduces buyers to farmers based on the excel data form (There are currently no communication methods to share information between farmers groups.)	Effective method for farmers' active engagements Small markets are also included in the market research. Actual selling price is also recorded. However, information exchange is limited to the members of the belonging farmers group Information exchange and input is done manually Market research is required to be done frequently.
Solutions welcomed for this RFP	**【 Same as current SHEP approach】**	**Ideas are welcomed (Devices that farmers and agricultural extension officers have are mentioned in the PoC section)**	**Ideas are welcomed (Devices that farmers and agricultural extension officers have are mentioned in the PoC section)**	**This RFP calls for a collaborative feature of a basic market information service and current SHEP approach.**

Source: JICA Survey Team

■ Functions and designs expected to come with a proposed approach:

- Provides incentives for users to collect and share information

- Matches a user with wholesalers/brokers

- Provides recommendations for users on wholesalers/brokers

- Supports different units of sales

- Allows wholesalers/brokers to enter information on the crops they wish to purchase, quantity they require, conditions of purchase, etc.

- UI/UX that is intuitive to operate even for users without information technology knowledge

PoC

- Demonstration period: From February to June 2021, approximately 3 months are planned.

- If it is difficult to travel to the site due to the influence of Corona, it is assumed that it will be demonstrated remotely.

- The demonstration site is expected to be selected from among the 25 provinces of Arusha, Kilimanjaro and Tanga, which are subject to the "Capacity Building Project for Implementing Prefectural Agricultural Development Plans Using the SHEP Approach" and among the 12 prefectures that receive priority assistance.

- Demonstration users are expected to be agricultural extension workers or farmers in the target region (Consultation regarding the number of demonstrators).

  [About agricultural extension workers]

  - Business: Provides agricultural management and technical guidance to direct producers.

  - Devices used: Some agricultural extension workers have smartphones, but the percentage is lower at the prefectural level. There are minimum facilities such as internet and personal computer at the prefecture level, but they often use old desktop PC. As part of the above project, we plan to purchase 5 tablets (Three of them are extension workers.) for the prefecture (For 12 prefectures, a total of 36 extension workers have tablet terminals). Since the OS is Android and we were planning to consolidate the guidelines of the SHEP approach (Total 6 GB), the HDD capacity (32 GB) is small, but we welcome proposals to make effective use of tablet devices. However, since the communication cost is expected to be borne by the user, we would appreciate it if you could consider a way to communicate only under the Wifi environment.

  [About Farmer Groups]

  - The project directly targets about 1,080 farmers (30 people/farmer group x 3 groups x priority support 12 prefectures).

  - Advanced farmers own smartphones, but many of them use feature phones.

- You basically need English to communicate with the local people.

- The preferred operating language for the solution is Swahili or English (Swahili language is required for operation, especially for extension workers and farmers.).

About " PROJECT FOR STRENGTHENING DADP PLANNING AND IMPLEMENTATION CAPACITY THROUGH USE OF SHEP APPROACH (TANSHEP)s"

- Project: Technical Cooperation

- Challenges: Agricultural and Rural Development

- Duration: January 2019 - December 2023

- Project Details URL: https://www.jica.go.jp/oda/project/1700376/index.html

- Summary:

  In Tanzania, agriculture represents an important sector that involves around 70% of its population and makes up for approximately 25% of its GDP. While some 80% of the population in the rural areas relies on agriculture for livelihood, it is low in productivity and profitability, and a shift to higher value-added agriculture is required to improve their levels of living and close a gap with the urban areas. The SHEP project is aimed at increasing agricultural income in the target areas through the establishment of the SHEP approach in Tanzania (TANSHEP), among others.

Farmer group developing a plan for
market research (Moshi)

TANSHEP workshop for farmers and
agricultural extension officers (Meru)

Market research for wholesalers
(Market in Arusha prefecture)

Baseline research by Farmer groups
(Karatu prefecture)

Figure 3-49   Cooperation Area Map

Source: JICA (https://www.jica.go.jp/oda/project/1700376/index.html)

（2）   Financial Sector

CHALLENGE

'Innovation to Facilitate Improved Financial Access for Small- and Medium-Sized Micro-enterprises Engaged in Rural Farmers/Farming and Processing'

(Examples of possible solutions)

- A solution to realize a microfinancing scheme for farmers and MSMEs engaged in agro-processing, etc.

- A solution that contributes to the improvement of financial literacy in rural areas

- A solution to make it possible to provide financial services even with poor infrastructure

BACKGROUND

While the financial access conditions in Tanzania are improving, a gap in access between urban and rural areas remains as an issue, with 72% of the urban population having access to financial services, compared to less than half of the rural counterparts at 48%. Behind this are factors such as challenging conditions of use of financial services (e.g, securities), low financial literacy in rural areas, and inadequate infrastructure for accessing financial services.

In this RFP, JICA seeks solutions that solve the above-mentioned challenges and help improve the financial access especially for agricultural workers and MSMEs engaged in agro-processing in rural areas in Tanzania

WHAT PARTICIPATE

- JICA will provide PoC opportunity (Expected to provide matchmaking opportunities with farmers)
- JICA will provide Proof of Concept (PoC) opportunity by providing the PoC fund of up to 3~5 million yen
- If the PoC is successful, there are possibilities for technologies/services to be introduced in JICA projects
- JICA will support the PoC by introducing the government agencies and public institutions in the country

POINTS TO CONSIDER

- 4G network is available, especially in the metropolitan areas; however, connectivity is poor in a number of areas, and it is desirable that a proposed solution should be applicable in such areas

PoC

- PoC Period：Approximately 3 months within Feburary to June 2021
- PoC will be conducted remotely in case of travel constraints due to COVID-19
- PoC location will be selected from the following. However, details of the location, local partners, users will be decided after discussions with the proposer. (There is a possibility for collaborating with a governmental financial institution in Tanzania that JICA currently has partnerships with. Specific details are to be discussed after the selection process.)
  - Example of potential collaboration: Project areas of JICA's "Project for Strengthening DADP Planning and Implementation Capacity through Use of SHEP Approach (TANSHEP)" will be possible PoC locations. Specifically, it is to be selected from among the 12 Priority Districts within the 25 districts in 3 regions (Arusha, Kilimanjaro, and Tanga). The project conducts an annual matchmaking event for farmers, agricultural businesses and financial institutions. Matchmaking event can be organized upon request as no matchmaking event is planned in present during the PoC period.

- Prospective users include agricultural extension officers and farmers' groups in the target areas
Agricultural extension officers
  - What they do: To provide agricultural management and technical guidance to producers

  - Devices used: While some agricultural extension officers own smartphones, ownership is low district-wide. Likewise, district-wide levels of internet connectivity and personal computer and other equipment availability are bare minimum, with many still using outmoded desktop PCs.

- Purchase of tablet computers is planned within the framework of TANSHEP, and five will be leased to districts, of which three will be for agricultural extension officers. As the project covers 12 districts, a total of 36 agricultural extension officers will have tablets. The operation system for the tablets will be Android; their HDD capacity is small (32 GB) as the capacity will be concentrated according to the guidelines on the SHEP approach (6 GB in total), but proposals that make effective use of tablet computers will be welcome. Because users are charged for mobile data usage, a proposed solution should be designed to offer a wifi-only mode, etc.

Farmers' groups

- Support provided to: Approx. 1,080 farmers (3 farmers' groups, each consisting of 30 farmers, per 12 Priority Districts)
- Devices used: While some farmers own smartphones, many use feature phones

■ English will be needed for communication with local counterparts
■ Languages of use: Swahili and English; Swahili is required especially if agricultural workers themselves are to use the proposed solution

Current Status of Financial Access in Rural Tanzania

■ Tanzania's financial inclusion rate is doubling in the past 10 years.
■ Users with informal financial services has decreased from 29% to 7%, and users with formal financial services has quadrupled.
■ In terms of the percentage of the population with access to a financial system, however, the gap between urban (72%) and rural (48%) areas remains an issue to be addressed.
■ Key factors identified to affect the improvement of financial access in rural areas include the following but other solutions are also welcomed.

[Challenge 1: (1) Challenging conditions for using financial services]

➢ In rural areas, there are great needs for small business loans that enable agricultural investment, yet few financial institutions provide small-scale loans. Users, meanwhile, are averse to the fact that infrequent, small-scale financing incurs high interest fees.

➢ There are many low-income users in rural areas, with few capable of offering land as collateral or providing a proof of real estate ownership.

➢ Furthermore, the current system denies access to financial services without a national identification number, which means financial services are not available for users in rural area who do not have national identification number
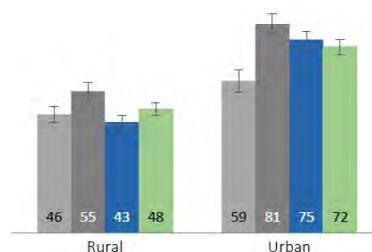
Figure 3-50   Trends in financial inclusion rate in Tanzania

Source: Kantar. "Tanzania Data at a Glance"

3-70

[Challenge 2: Low financial literacy in rural areas.]

➢ In Tanzania, lack of basic financial knowledge and low education completion rate remain as an issue.

➢ Agricultural workers with secondary education remains to be 8%. Moreover, women without primary education accounts for 23%. Therefore, lack of knowledge in financial services and literacy rate remains an issue.

➢ Financial service utilization rate is particularly low for women and agricultural workers with low literacy rate and education level as well as young population below 24 years old.

Figure 3-51   Groups with low financial inclusion rate in Tanzania

Source：FinScope (2017)

[Challenge 3: Inadequate infrastructure for accessing financial services][4]

➢ In Tanzania, lack of basic financial knowledge and low education completion rate remain as an issue.

➢ Agricultural workers with secondary education remains to be 8%. Moreover, women without primary education accounts for 23%. Therefore, lack of knowledge in financial services and literacy rate remains an issue.

➢ Financial service utilization rate is particularly low for women and agricultural workers with low literacy rate and education level as well as young population below 24 years old.

Figure 3-52   Percentages of population living within 5km of a financial institution

Source: FinScope (2017)

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[4] Finscope (2017) "Insights that Drive Innovation - Tanzania"; Finscope (2017) "Agriculture Niche Report"

Reference: About "PROJECT FOR STRENGTHENING DADP PLANNING AND IMPLEMENTATION CAPACITY THROUGH USE OF SHEP APPROACH (TANSHEP)"

- Project: Technical Cooperation

- Challenges: Agricultural and Rural Development

- Duration: January 2019 - December 2023

- Project Details URL: https://www.jica.go.jp/oda/project/1700376/index.html

- Summary:

In Tanzania, agriculture represents an important sector that involves around 70% of its population and makes up for approximately 25% of its GDP. While some 80% of the population in the rural areas relies on agriculture for livelihood, it is low in productivity and profitability, and a shift to higher value-added agriculture is required to improve their levels of living and close a gap with the urban areas. The SHEP project is aimed at increasing agricultural income in the target areas through the establishment of the SHEP approach in Tanzania (TANSHEP), among others.

Farmer group developing a plan for market research (Moshi)

TANSHEP workshop for farmers and agricultural extension officers (Meru)

Market research for wholesalers (Market in Arusha prefecture)

Baseline research by Farmer groups (Karatu prefecture)

Source: JICA (https://www.jica.go.jp/oda/project/1700376/index.htm)

3.5.3 Screening Result

(1) Applicants

In the field of agriculture, a total of 11 companies from 7 countries (Japan, Ghana, India, Tanzania, the Netherlands, the United States, and Mozambique) applied. Companies and universities were among the applicants.

In the field of financial inclusion, 12 companies from 7 countries (Japan, Tanzania, Kenya, the Netherlands, Uganda, South Africa, and Luxembourg) applied. Companies and universities were among the applicants.

(2) Results

A review was conducted based on the review criteria described above, and three companies in agriculture and four companies in financial inclusion passed the primary review, and an online interview was conducted. The purpose of the online interview was to improve the solution and demonstration plan by deepening the understanding of both the JICA side and the applicant company side and especially deepening the understanding of the field needs and the field situation by the applicant company side, and to have them participate in the final examination.

As a result of the review, Syno Japan, a Japanese branch of a European startup, was selected in the field of agriculture to enhance the autonomy, competence, and relationships of Tanzanian agricultural extension workers and farmers, from the establishment of online marketplaces and centralized data management, to the collection, sharing, and utilization of market information.

In the financial sector, HAKKI AFRICA, which provides microfinance for small business owners in Kenya, was selected. The company's solution, which included innovative ideas and financial education to process credit scoring from ultra-small loan repayment data, was selected for this theme.

3.5.4   PoC Implementation (Agriculture Sector)

(1)   PoC Overview

The objective of this POC was to collect and accumulate information such as market survey results from farmers who have mastered the SHEP approach, and then share the information within the farmer group and with farmer groups in other regions, in order to build a solution to increase the effectiveness of the SHEP approach. Anzia Sokoni, which was developed for the above purpose, includes the following mechanisms to streamline the process of market research data collection, centralized data management, data sharing and utilization by Tanzanian farmers based on the SHEP approach.

➢ Data collection: A system for Tanzanian farmers to efficiently collect market information such as market prices and needs, and upload all data to a centralized system.

➢ Data linkage: A mechanism for Tanzanian farmers to upload existing market information services that can be used to understand their markets into a centralized data management system.

➢ Centralized data management: A system for centralized management of all collected and linked data

➢ Data sharing: A mechanism to efficiently share centrally managed data with others.

➢ Data utilization: A mechanism for utilizing centrally managed data

The actual functions of the developed application are as follows (as seen by the user)

Home menu: Explains the concept of SHEP.

➢ Post menu: Allows users to post messages, photos, and videos. The administrator can also delete postings that are deemed inappropriate. Users can also edit and delete their own posts.

➢ People menu: Allows users to view information about other participants and to do networking.

➢ Market Survey menu: Users can view all the data (market survey prices, actual sales prices, etc.) that have been entered and stored in the system so far. Users can also edit the data they have entered.

➢ Action Plan menu: Lists the results of market research, prices heard during cultivation, and actual sales prices entered by the farmers themselves.

➢ Business Plans menu: Buyers can enter information about the crops they want to buy and sell, including the prices. This information will be automatically uploaded to the buyer information in the People menu, and will be used for matching with farmers.

➢ My Profile menu: Allows userst enter their information.

In addition to a web browser, Anzia Sokoni will also prepare an application with the same content for use in situations where there is no or weak communication, and once the application is installed on the user's device, the user will be able to enter market research data offline. Once the app is installed on the user's device, the user can input market research data offline. The system was also set up to lighten the data transmission even under weak communication.

For users who do not own a PC, smart phone, or tablet, a system will be established to share the collected market and trading information with farmer extension agents who own a desktop PC, tablet, or smart phone, and have them upload the information on their behalf. In addition, for those who have feature phones, a system to send and receive information via SMS will be established.

(2)　Results

The purpose of the PoC was to verify the compatibility of the system concept with the local market and the practicality of the system itself in the local market through the use of the constructed system by expected users, and to customize and improve the system based on the verification results to make it more useful in the local market.

Based on the above objectives, interviews and PoC were conducted as follows.

Pre-PoC (Interview)：Interviews with farmers, extension agents, and buyers were conducted as a pre-PoC to confirm the direction of the system development.

PoC for farmers, extension agents, and buyers: The system was developed based on the interview results, and PoC was conducted for Tanzanian Ministry of Agriculture staff, farmers, extension agents, and buyers. Afterwards, the system was customized based on the comments received from the PoC participants. In the implementation of the PoC, the direction of the system development and items for modification and improvement were discussed through regular meetings with TANSHEP experts from the start of the project, and were reflected in the system development and customization.

Objectives of the pre-PoC (interviews) and items to be verified: In order to lead to the development of a system to be used locally, interviews were conducted with the following objectives.

➢ Understand the current status of the assumed local system user personas.

➢ Clarify the direction of development and what is important to focus on during development.

➢ Identify the utility of the prototype at the same time and areas for improvement.

In order to achieve the above objectives, the following questions were asked to each assumed user in the interviews.

Extension agents：

➢ Status as an extension agent (nature of work, career, importance of working as an extension agent, frequency of visiting farmers, status of conducting market research, use and sharing of market research data)

➢ Ownership and use of digital devices

➢ Design of the system, usefulness of the system menu

Farmer：

➢ Status as a farmer (types of crops cultivated, scale of cultivation, important considerations when cultivating, status of market research, status of data utilization when cultivating and data content, etc.)

➢ Ownership and use of digital devices

➢ Design of the system, usefulness of the system menu

Buyer：

・Status as a buyer (types of crops handled, scale of transactions (volume and price), important points at the time of transactions, current status of information gathering, status of data acquisition related to transactions, etc.)

➢ Ownership and use of digital devices

➢ Design of the system, usefulness of the system menu

Methodology for conducting the pre-PoC (interviews): To conduct the interviews, we first set the criteria for selecting interviewees with advice from TANSHEP experts. Then, we asked the prefectural staff of Moshi Province, who were already working on TANSHEP projects, to search for interviewees based on the criteria, and selected three farmers, three extension agents, and three buyers from among the candidates. The reason for conducting the interviews in Moshi Province was that the TANSHEP project was already underway there and the TANSHEP office was available as an interview venue.

The interviews were conducted over three days from April 21 to 23, 2021, in Moshi Province. Syno Japan participated in all interviews online and asked additional questions through the assistant as needed. During the interviews, the assistant's PC was used to display a prototype of the system, introduce its design and functions, and listen to the participants' opinions. The interview schedule and work process are as follows.

Table 3-19 Interviews schedule and work process

Day	Start	End	Program	Interviewee
Day1 April 21 (Wed)	8:30	9:00	Connection/ Introduction	
	9:00	11:00	Interview 1	District Officer (Mr. Hamza)
	11:00	11:30	Tea Break	
	11:30	13:30	Interview 2	Extension Officer 1 (Mr. Bashiri)
	13:30	14:30	Lunch	
	14:30	16:30	Interview 3	Extension Officer 2 (Ms. Grace)
Day2 April 22 (Thu)	8:30	9:00	(Review as required)	
	9:00	11:00	Interview 1	Farmer 1(Mr.Bakari)
	11:00	11:30	Tea Break	
	11:30	13:30	Interview 2	Farmer 2(Ms.Victria)
	13:30	14:30	Lunch	
	14:30	16:30	Interview 3	Farmer 3(Mr.Charles)
Day3 April 23 (Fri)	8:30	9:00	(Review as required)	District Officer
	9:00	11:00	Clarification on Day2	Buyer 1(Mr. Lameck)
	11:00	11:30	Tea Break	
	11:30	13:30	Interview 2	Buyer 2(Ms. Glory)
	13:30	14:30	Lunch	
	14:30	16:30	Interview 3	Buyer 3(Mr. Hassan)

Source: Report by Syno Japan

Status of achievement of the objectives of the pre-PoC (interviews): Through the interviews, we were able to get an overview of the situation of the expected local users, including their work conditions, difficulties in the work, data utilization, and device usage. It was found that farmers, extension agents, and buyers all felt the importance and necessity of collecting, sharing, and using information and data related to their work and operations, and also understood that the use of data can lead to improved work and operations, and thus improved income. Therefore, it was clear that the purpose and direction of this system to improve the efficiency of data collection, sharing and utilization is consistent with the intentions of Tanzanian agricultural stakeholders. On the other hand, since farmers are more likely to use feature phones than extension agents and buyers, the need for a function that would allow feature phone users to use the system was reaffirmed. In addition, user-friendly design and operability improvements, including system colors, were also recognized as items to be addressed in the future.

Objectives and validation items of the PoC for farmers and extension agents: In order to develop a system that can be used and utilized in the field, the PoC was conducted with the following objectives

➢ Confirm the purpose of using the system for local users and the operability of the system.

➢ Check for recommendations to others.

➢ Identify areas for improvement in the system at the same point in time.

In the PoC, in order to achieve the above objectives, the system was used by 15 extension officers (5 officers in 3 prefectures) and 27 farmers covered by those extension agents (9 farmers in 3 prefectures), and an online questionnaire was conducted regarding the purpose of using the system, operability of the system, and recommendations for improvement of the system.

Methodology for conducting the PoC for farmers and extension workers: The PoC was conducted in the three provinces where TANSHEP is conducting its initial batch activities (Moshi, Lushoto, and Meru). The reasons for this were that the farmers and extension workers had a certain level of understanding of SHEP due to the fact that they were already working with TANSHEP, and that TANSHEP had already distributed tablets to the extension workers as equipment for the activities, so they had all the necessary equipment for the PoC.

The participants in the PoC were 8 task force members (TFs), who are the local counterparts of the TANSHEP project, 15 extension workers who received tablets in each prefecture (5 from each prefecture x 3), and 27 farmers (9 from each prefecture x 3) who were in charge of the extension workers. In the beginning, buyers were also invited to participate. Initially, buyers were also planned to be included in the PoC, but since the way buyers use the system is different from other users, it was decided to conduct the PoC separately.

The PoC was conducted over three days from July 26 to 28, 2011. On the second day, three TFs in each province were instructed to explain the system to farmers and extension agents, and to work together with the participants on the actual operation of the system. Three local assistants also participated in the PoC in each province to support the TFs, and Syno Japan members responded to local questions online during each PoC. At the end of the PoC, all participants were interviewed through an online questionnaire to verify the results. After two weeks of training, the same interviews were conducted by phone to obtain additional feedback from the participants. The implementation schedule and work process are shown in the chart below.

Table 3-20   PoC implementation schedule and work process

- **Date of PoC :** 26, 27, 28th of July
- **Days of PoC:** 3 days
- **Deadline of sending feedback on prototype :** in 2 weeks after PoC

	Date	Duration(Tanzania time)	Place	Contents	Person in charge Syno Japan	Person in charge TF or RAS	Remarks
Day 1	26th July	From 10:00 to 14:00 (include one hour lunch break)	Kilimanjaro	PoC with TF and RAS members	✓		· include training how to use system (Farmer, Buyer and Extension officer usage flow) · Each TF and RAS members will go back to their own region after this PoC for Day 2 or Day 3 PoC
Day 2	27th July	From 10:00 to 15:00 (include one hour lunch break)	Kilimanjaro and Arusha	PoC with DFT, WAEO/VAEO and Farmers		✓	· include training how to use system · using previous market survey data for practice
Day 3	28th July	From 10:00 to 15:00 (include one hour lunch break)	Tanga	PoC with DFT, WAEO/VAEO and Farmers		✓	· include training how to use system · using previous market survey data for practice
Deadline of feedback	11th August	-	-	Sending feedback on prototype through link	All participants in PoC should send feedback.		

Source: Report by Syno Japan

【Results and achievement of objectives of the PoC for farmers and extension agents】

In the PoC for farmers and extension agents, an online questionnaire was conducted and validated for the following items. The results of the verification for each item are as follows.

Most important purpose of the system: About 50% of the users said that the most important purpose of this system is to help them collect, input, and share market research, which clearly shows that the users also understand the direction of the system development through the system.
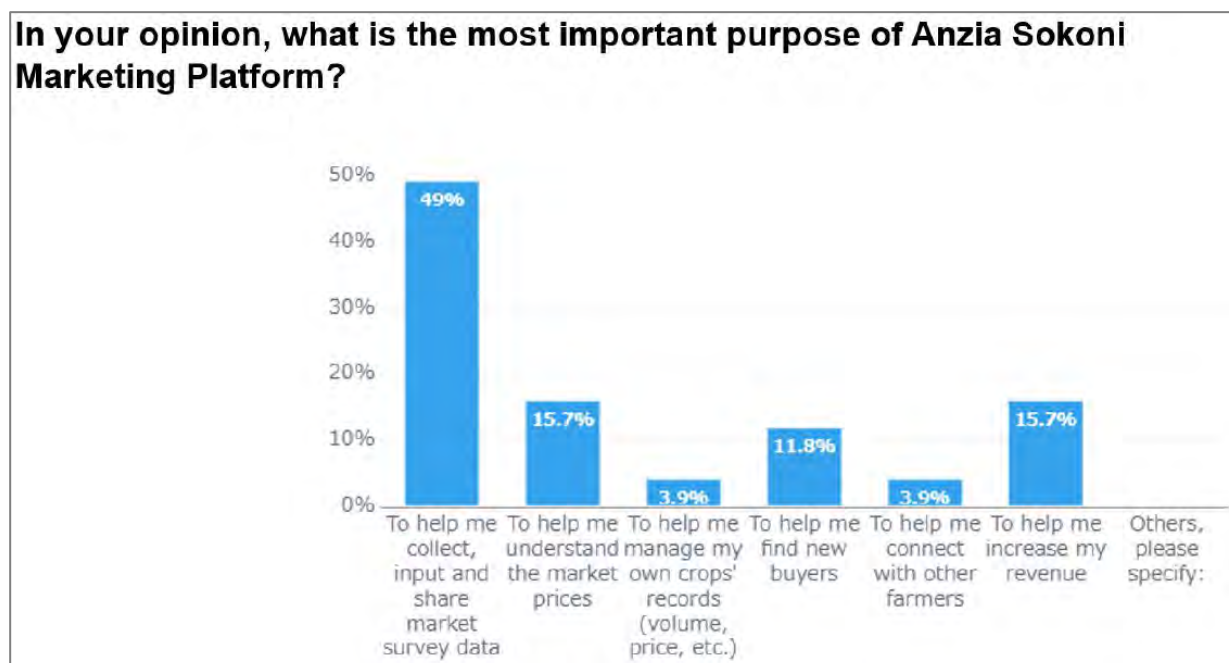
Figure 3-53   Questionnaire results on the purpose of the system

Source: Report by Syno Japan

System operability: We achieved our goal of obtaining a rating of 6 or higher out of 7 from more than half of the participants in all of the following areas: registration/login, Post menu, People menu, Market Survey menu, Action plan menu, and My profile menu. However, it was also confirmed that about 30% of the participants felt difficulty in registering and logging in, and about 20% felt difficulty in Market Survey and Action Plan.
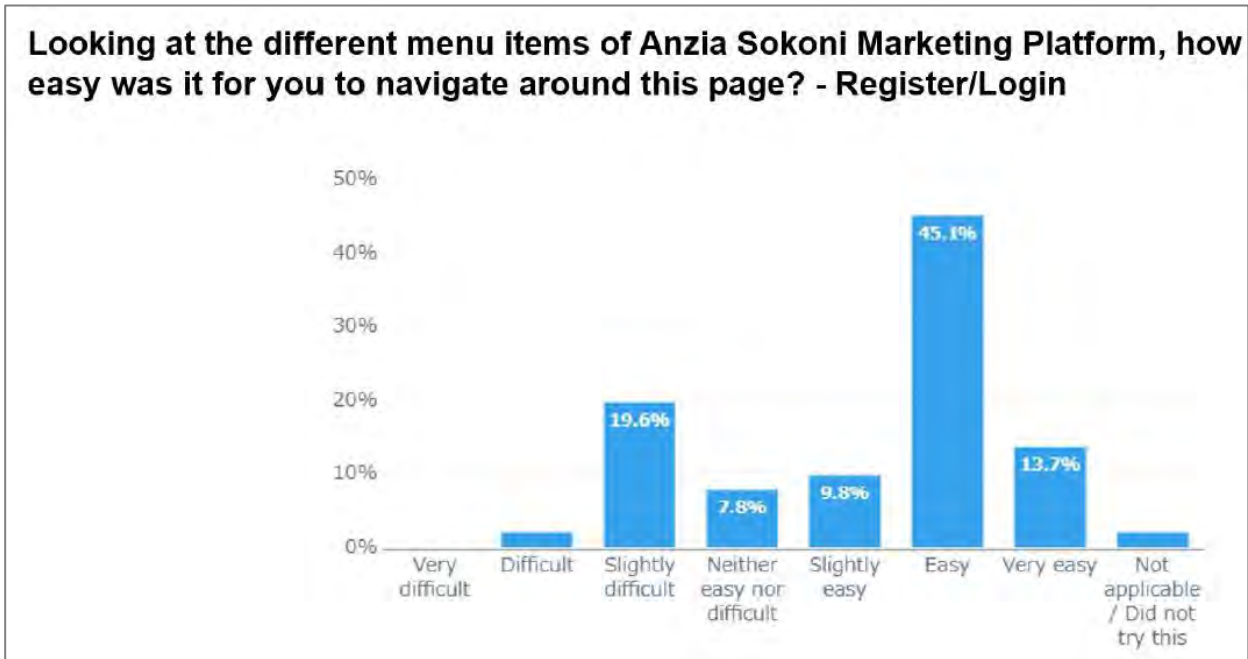
Figure 3-54   Results of a survey on the usability of registration/login
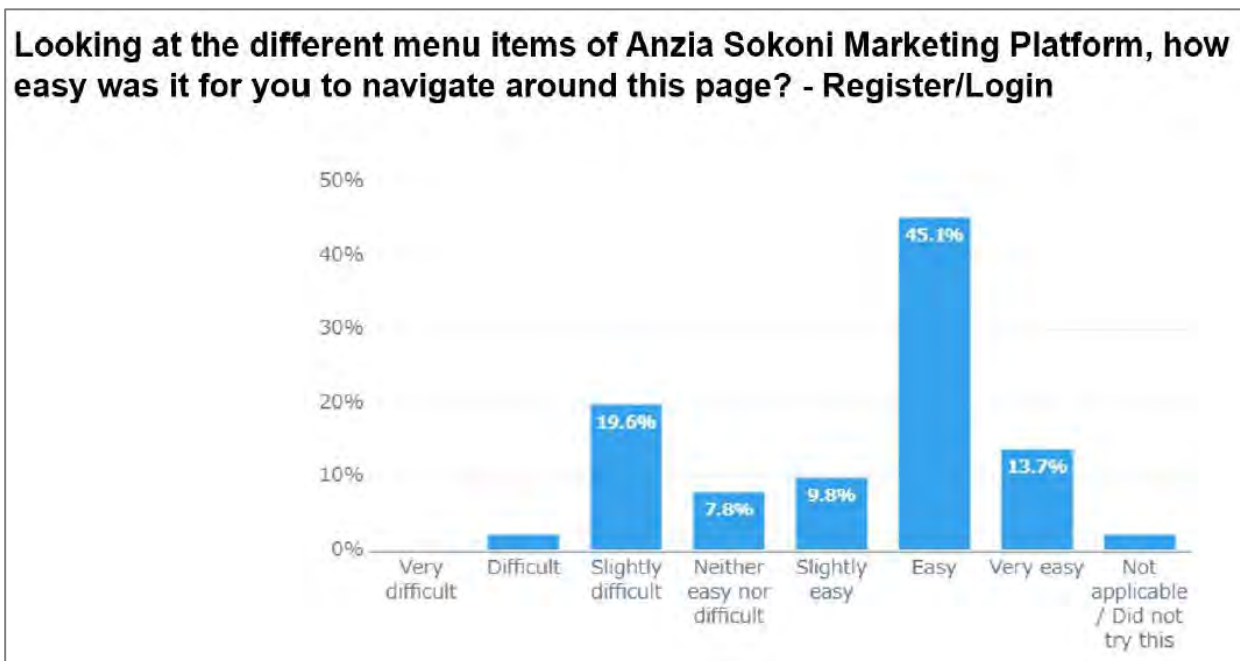
Figure 3-55   Results of a survey on the operability of the Post menu
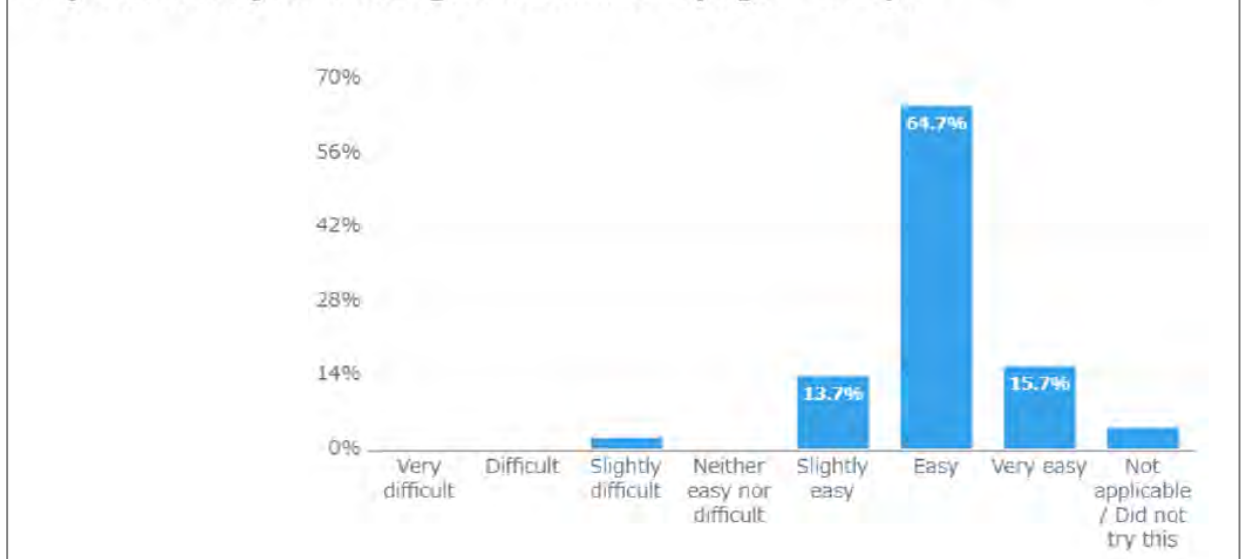
Figure 3-56   **Results of a survey on the operability of the Peopel menu**
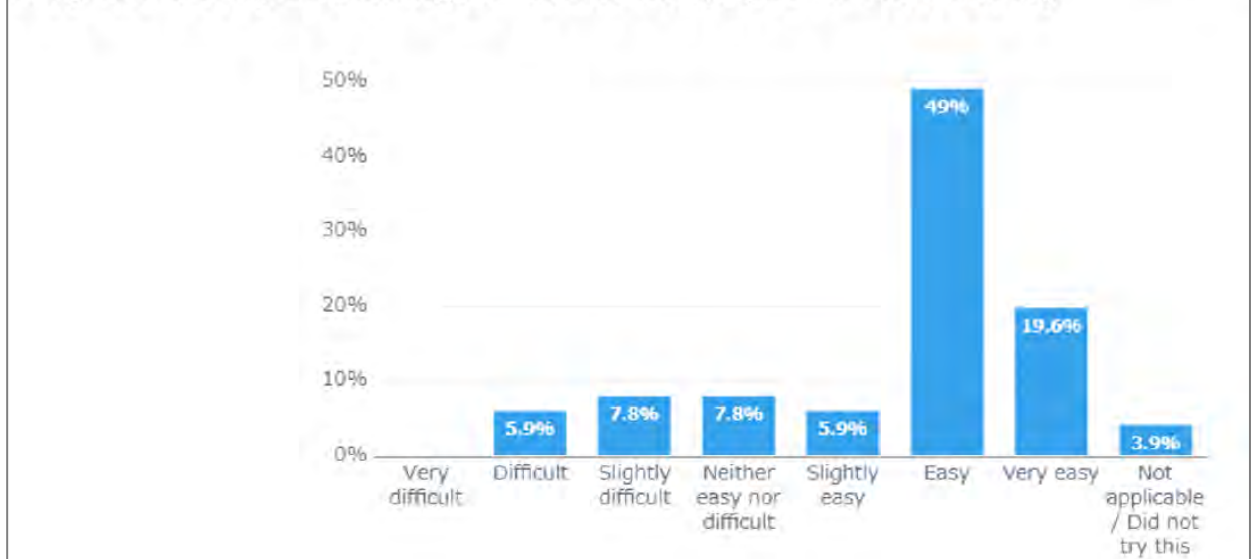
Figure 3-57   **Results of a survey on the operability of the Market Survey menu**

Looking at the different menu items of Anzia Sokoni Marketing Platform, how easy was it for you to navigate around this page? - Action plan
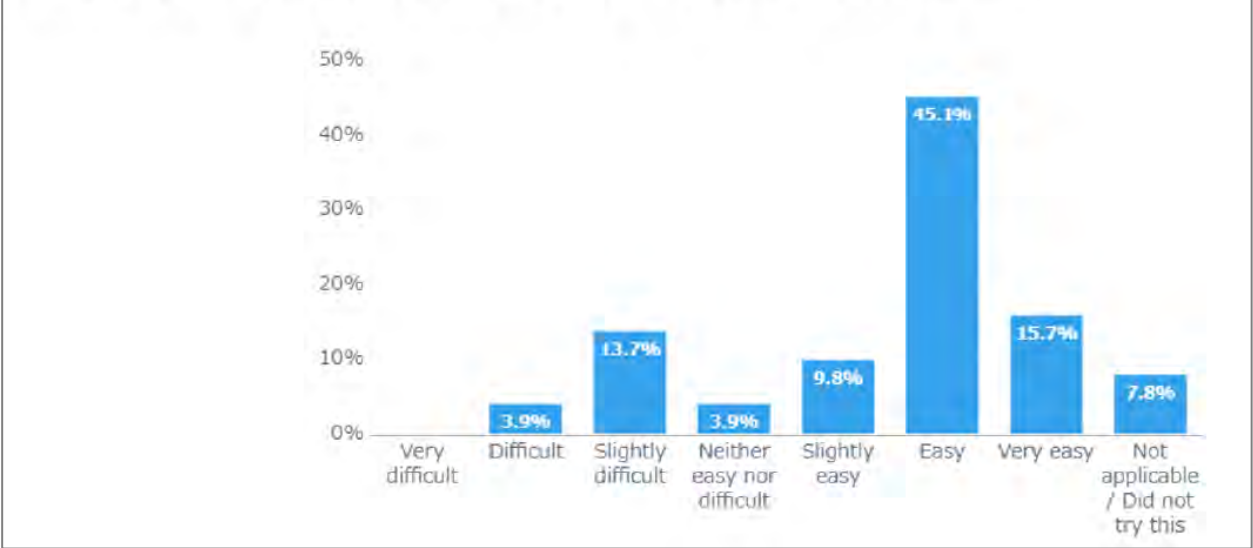
Figure 3-58   Results of a survey on the operability of the Action Plan menu

Source: Report by Syno Japan

Looking at the different menu items of Anzia Sokoni Marketing Platform, how easy was it for you to navigate around this page? - My Profile
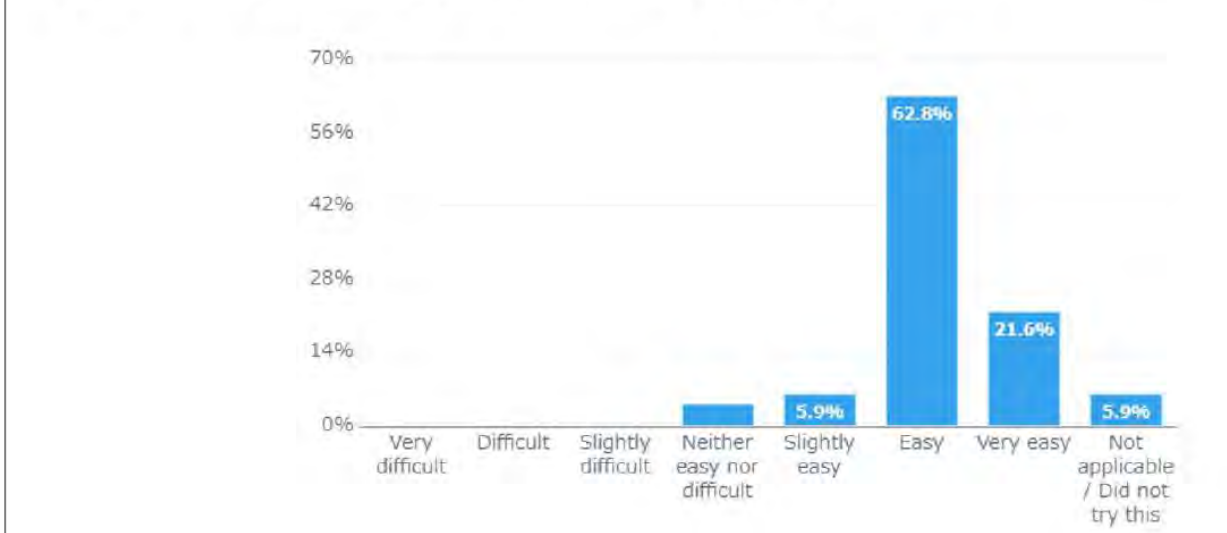
Figure 3-59   Results of a survey on the operability of the My Profile menu

Source: Report by Syno Japan

Degree of recommendation to others: With regard to the degree of recommendation to others, the goal was to obtain a rating of at least 8 out of 10 from more than half of the participants, and that goal was achieved.
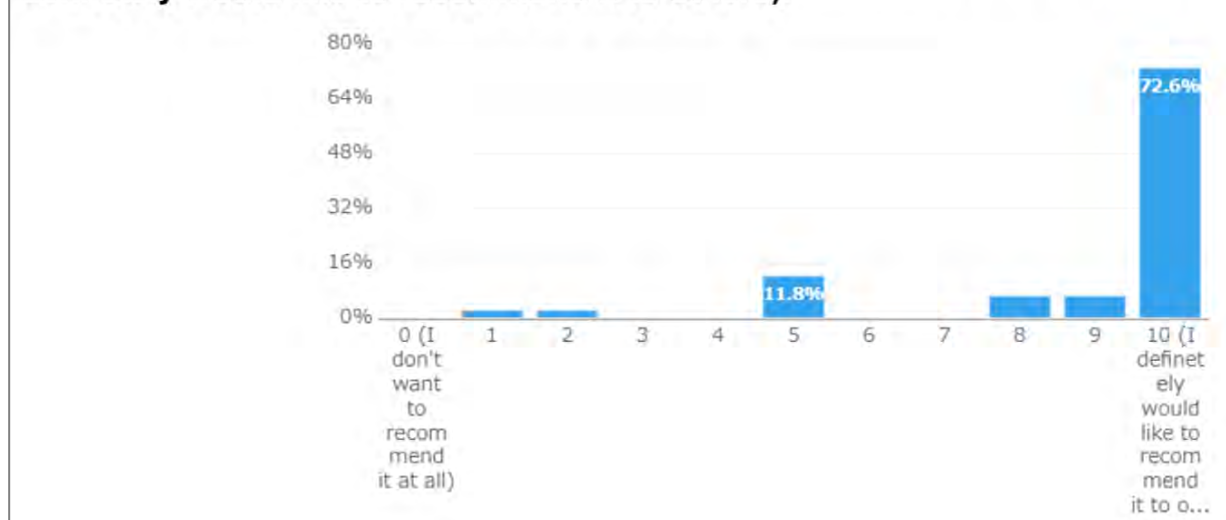
Figure 3-60   Results of the survey on the degree of recommendation

Improvements to the system: Through questionnaires and other means, several meaningful improvements were heard, including the following examples.

➢ To enable feature phone users to use the system, USSD service settings are required.

➢ It would be better to set an indication of the minimum and maximum prices.

➢ The list of crop types and target markets is limited.

➢ Users need to be able to edit and delete their own posts in the Post menu.

Objectives and verification items of the PoC for buyers: In order to develop a system that can be used and utilized locally, we conducted a PoC for buyers with the following objectives.

➢ Confirm the purpose of using the system for local users and the operability of the system.

➢ Check for recommendations to others.

➢ Identify areas for improvement in the system at the same point in time.

Verification items in the PoC for buyers: In order to achieve the above objectives in the PoC for buyers, a questionnaire was conducted on the following items after having each participant use the system.

➢ Purpose of using the system

➢ Operability of the system

➢ Degree of recommendation to others

➢ Improvement of the system

Method of conducting PoC for buyers: The PoC for buyers was conducted in Moshi province on October 22, 2021, with three buyers who participated in the interviews and four of their colleagues. On the day of the PoC, the assistant explained the use of the system to the buyers in Swahili, and then each buyer operated the system using his or her own device. After the PoC, the assistant asked the buyers to continue using the system, and five days after the PoC, the assistant contacted each buyer by phone to collect additional feedback.

Table 3-21 Implementation schedule and work process of PoC for buyers

| | | Flow of small PoC with buyer | | | |
		Item	Content	Participants	mins
22nd Oct	1	Demo of Anzia Sokoni Marketing Platform	Mr. Imani conduct demo of Anzia sokoni by sharing his device screen with buyers. And Q&A	seven buyes : ·Mr. Lameck J. Mmbaga/55 years/Male ·Ms. Glory H. Msangi/51 years/Female ·Mr. Hassan Abdallah/43 years/Male ·Yohana Simon/29 years/Male ·Verani Aloyce/34 years/Male ·Hussein Msangi/32 years/Male ·Eward Kimario/26 years/Male	30mins
	2	Trial using of the platform by buyer	Sharing user guide data and URL of Anzia Sokoni with buyer, and ask them to use system.		60mins
	3	answer survey	Mr. Imani will ask questions to each buyer based on paper questionnaire and write down their answer on it. later share this data with Syno Japan through email.		20mins
	4	Payment for buyers	after collection of answer survey, Mr. Imani pay incentive to buyer.		
28th Oct~	1	Feedback survey	Mr. Imani contact to seven buyers after 5 days of demo and trial, and ask questions based on paper questionnaire(word file) to buyer and write down their answer when they have any additional comments.		30mins

Results of verification in the PoC for buyers: In the PoC for buyers, questionnaires were conducted and verified for the following items. The results of the verification for each item are as follows.

➢ Purpose of system use: Identify which purpose is most important to local users.

➢ Results: 3 out of 7 respondents chose "to understand market prices" and 4 chose "to increase income".

➢ Operability of the system: For the operability verification item, the goal is to obtain a rating of 6 or higher out of 7 from more than half of the participants.

➢ Results: We achieved our goals for Registration/Login, Post, People, and My Profile, but not for Market survey, Business plan, Finding the information you want under "Results" in Market survey and Adding a new plan in Business plan were not achieved. Therefore, we asked each participant to continue using the system after the PoC for the market survey and business plan, and obtained feedback again 5 days later. After five days, we received feedback from all the participants who had selected 4 or 5 levels in the market survey and business plan, and they commented that they had become familiar with the system and were able to teach their colleagues how to use it.

➢ Degree of recommendation to others: For the degree of recommendation to others, the goal was to obtain a rating of at least 8 out of 10 from more than half of the participants, and as a result, all 7 participants chose "10: I would definitely recommend the system to others.

➢ Improvements to the system: One suggestion for improvements to the system was the need for an application that could be downloaded to smartphones and tablets, rather than a browser version. There was also a suggestion that continued practice and training is needed.

Implementation of additional PoC training: Although the objectives for each of the above activities were achieved, the need for training was raised by the participants in each PoC. Therefore, with the aim of promoting Anzia Sokoni in Tanzania in the future, additional training was conducted for extension workers and farmers involved in TANSHEP activities during the project period. It was decided to conduct additional training for extension workers and farmers involved in TANSHEP activities during the project period.

The scheduled dates for the training were December 28 and 30, 2021, but Tanzania asked for a change in the schedule on December 30, and the training was moved to January.

The training will be conducted in Karatu and Bumburi districts, and participants will include one TF member from each district, one assistant from the TANSHEP team, one assistant from Tohmatsu, two staff from each district, three extension workers, and three farmers from each district.

Table 3-22   Timeline and work process for conducting additional training (same schedule for both days)

Day	Time	Place	Participant's device usage	Flow of Training
Day1 28th Dec	8:30(Tanzania) (14:30 JST)	District office of Ministry of Agriculture	Projector PC or tablet : ・Each TF and DFT member need to bring their own PC/tablet ・Each WAEO/VAEO need to bring their tablet which is provided by TANSHEP ・Mr. Imani need to bring his PC	Gathering to venue
	8:30～9:00(Tanzania) (14:30～15:00 JST)			・Courtesy call (by TF member and Mr. Imani) ・Checking name list ・Preparing devices
	9:00～9:30 (15:00～15:30 JST)			Introduction of Anzia Sokoni
	9:00～10:30 (15:00～16:30 JST)			Training of Farmer flow Part 1
	10:30～11:00 (16:30～17:00 JST)			Tea break
	11:00～12:00 (17:00～18:00 JST)			Participating in PoC of Farmer flow Part 2
	12:00～13:30 (18:00～19:30 JST)			Participating in PoC of Farmer flow by each farmer
	13:30～14:00 (19:30～20:00 JST)			Lunch
	14:00～14:30 (20:00～20:30 JST)			Participating in Training of PoC Extension officer flow
	14:30～15:30 (20:30-21:30 JST)			Answering onliin survey
	15:30～			Payment for each participants

Source: Report by Syno Japan

(3)   Post-implementation deployment plan

➢   Potential for future business development and collaboration with ODA projects

Initially, the business model envisioned was to provide licenses for the developed system to governments in countries that have already implemented or will implement JICA's SHEP, and to build a platform that reflects the needs of users (farmers, extension officers, users) and SHEP teams in each country. In Tanzania, it was envisioned that the Ministry of Agriculture would operate the system on its own (with Syno Japan providing additional development and operation services as needed). However, in consideration of the actual operational experience, the number of users, and the cost burden on the government, another business development plan was to provide a license for the platform and future customization and additional development to JICA headquarters as an educational tool when JICA implements SHEP in each country. One idea is to establish a "JICA Global SHEP Platform (tentative)" to (1) disseminate the platform to Tanzania, (2) disseminate the platform to other SHEP implementing countries, and (3) introduce the platform to future SHEP implementing countries.

In addition to educational tools, the platform can also be used to gather macro and micro insights to understand the market in each SHEP country by disseminating the platform across the globe. Furthermore, by establishing a scheme to provide the insights gained from the platform to external parties, rather than

limiting them to JICA, it will be possible to cover the cost of licensing and additional development of the system, and to operate the platform in a more sustainable manner. The ultimate goal will still be to provide licenses for the system to governments as originally planned, but we believe that the hurdles to granting licenses to governments will be lowered compared to the current situation by providing a scheme that covers (1) a certain level of operational performance, (2) the number of users, and (3) the cost of licenses. It is thought that the hurdle for granting licenses to governments will be lowered.

➢ Market Analysis

If the platform developed in this study is to be deployed in Tanzania, the competition will be similar tools that are already in use locally. In this study, we conducted a competitive comparison with Killimo, which is being developed by the Tanzanian government. While this platform focuses on data collection and sharing based on SHEP, MKillimo focuses on matching with buyers. Therefore, we believe that both systems have the potential to coexist. On the other hand, spreading the use of the system among Tanzanian farmers is essential for market development, but Killimo is struggling in this area. As for the knowledge and insights that can be gained from the cross-country implementation of this platform, it is difficult to determine the scale of the market due to the lack of precedent, but at the very least it is a highly novel business model and there is no competition.

The risks and measures to be taken in order to develop this platform not only in Tanzania but also globally can be summarized as follows.

➢ Differentiation from tools that already exist in each country

In many JICA-supported countries, there are tools that already exist, such as in Tanzania, that provide information and match buyers with farmers developed by the government or local companies. Therefore, when proposing a platform based on the SHEP principles developed this time, there may be concerns about implementing the system due to similarities with existing tools. As a countermeasure, it is necessary to clarify the points of differentiation from existing systems, and with actual examples of SHEP in operation, encourage the government to introduce the system in the future. It should also be emphasized that farmers do not need to use multiple tools, and that the technology can be integrated with existing systems.

➢ User-centered design and customization

As we expand the platform we have developed to Tanzania and other countries, there is a possibility that the platform will not penetrate beyond the current SHEP users because it does not meet their needs in terms of functionality and usage. As a countermeasure, it is necessary to observe the user's experience when deploying to non-SHEP users, and always design and customize the platform in a user-centered manner. In particular, when implementing the platform in a new country, it is advisable to conduct design research again with the expected local users and implement a method that takes into account the differences between users in each country, rather than just implementing the platform out of the blue.

➢ Constant feedback and dialogue with governments

In order to develop a system that is designed to be used by the government of the other country, progress must be shared with the said governmen on a regular basis, otherwise it may diverge from the direction of the government that will be the future user. As a countermeasure, it is necessary to constantly communicate with the TF members to share the status of the platform's use, updates on its functions, and users' opinions, so that their perceptions are aligned.

(4) Lessons learned

Considerations for implementation and operation include training, feedback, scalability, local support, and ambassadors, as follows.

➢ Additional training for local users on how to operate the system

The system developed this time has a user-friendly and simple UX/UI through preliminary user interviews and several PoCs, and the user guide is available in Swahili, but further training may be required depending on device availability, literacy, and data and system literacy.

➢ Use of feedback function

There is a function in the system that allows actual users to send feedback to Syno Japan, the company that developed the system. It is necessary to inform users and local staff in advance that what we have developed this time is a system with the minimum necessary functions, and that we will improve it flexibly according to the feedback.

➢ Extensibility of functions

The current system includes mechanisms for data collection, sharing, and matching with buyers, and can be used regardless of whether or not the user owns a smartphone. In the future, it should be noted that the system is highly scalable, with the addition of a payment function linked to mobile money and a recommendation function based on actual user usage.

➢ Acquire new users through existing app users (ambassadors)

In order to increase the number and penetration of users of this system, we believe that it would be effective to use users (farmers, extension agents, buyers) who frequently use the system, utilize it in their actual business, and gain benefits from it as ambassadors, and use them for PR and training for other farmers, in order to organically increase the number and satisfaction of users.

Future issues and measures to be taken include the actual operation of TANSHEP and securing the number of users, as described below.

➢ Actual operation at TANSHEP

During the development of this system, improvements were made repeatedly based on pre-PoC interviews, PoC with farmers, extension agents, and buyers, and training and feedback to TF members, but the actual operation at TANSHEP will not start until the next fiscal year, and However, the actual operation of the system in TANSHEP will start from the next fiscal year, and it is expected that there will be issues that will become apparent through the operation (e.g., improvements in the use of the system using feature phones and farmers' inability to immediately understand the actual charts). As a countermeasure, depending on the coordination between JICA and Syno Japan, the use of TANSHEP from next year onwards will continue to be a test period, and we are considering cooperating with local supporters to flexibly improve the system based on local usage conditions and feedback.

➢ Ensuring the number of users

The platform needs to be used by as many users as possible of farmers, buyers and extension agents from various walks of life to experience its effectiveness. However, at present, the use of the platform is limited to the users and stakeholders who participated in the PoC. In order to increase the value of the platform in the future, one idea is to set the number of users as a KPI in addition to the functionality. In addition, in order to increase the number of users, a system that allows actual users to introduce the platform to non-users (with incentives such as points for referrals) should be added, so that the platform can spread to potential users within and outside of SHEP by word of mouth. By adding a mechanism that allows actual users to introduce the platform to non-users (with incentives such as points for referrals), we hope to build a mechanism that will spread the platform to potential users within and outside of SHEP by word of mouth.

The lessons learned and recommendations from this PoC are as follows.

➢ Importance of agile development based on design thinking

The development of this platform was based on a design thinking approach, where the current situation was first grasped and issues were clarified through interviews with the expected users and related parties, the ideal flow was designed, and then a prototype with the minimum necessary functions was developed, followed by repeated proof-of-concept (PoC) experiments involving the interviewed users and agile customization.

While based on the initial proposal, the detailed functional requirements and flow of the system were based on this approach, and we believe that it was this approach that enabled us to build a system with user-centered design. Conventional system development projects tend to be waterfall projects where the requirements are decided first, but agile development based on design thinking is a development method that allows the people involved to become more seriously as "their own matter" in the long run, although it takes time because it is created together with the users and local stakeholders. Therefore, it is expected to have a longer-lasting effect than the conventional method of unilaterally creating and spreading the technology.

➢ Step-by-step customization and expansion

In order for the system to penetrate the local market, it is important to customize and expand the functions flexibly based on the actual operation after the PoC. In this PoC, we always conducted a questionnaire after the PoC to get feedback from local users, which we immediately applied to the development.

➢ Building strong relationships with local people and experts

This time, we were unable to visit the site even once to develop the system, especially because of the Corona disaster. It would have been difficult to understand and develop the system expected by the users without the support of the local experts and TANSHEP specialists in the interviews, PoC at the site, and regular meetings. It became clear that it is effective to establish a relationship with experts who are always familiar with local information and how to proceed, and who can provide advice.

➢ Exploring the possibility of an exit strategy

As mentioned above, at the beginning of the project, it was assumed that the application to be developed would be completed and then operated independently by the Tanzanian Ministry of Agriculture. However, there were times when the original exit strategy did not work as expected due to difficulties in licensing the application to the Tanzanian government and concerns about conflicts with the existing system M-Killimo. In order to consider such possibilities in advance, it became clear that it is important to understand the existing system in advance and to consider other exit strategies in advance.

➢ Co-creation data platform, a new possibility for data business

The platform construction proposed as an exit strategy for this project is a data business model that Syno Japan is already developing as a smart city project for other local governments, tourism organizations, and other public institutions. The data obtained from the platform will be paid for not only by the users (in this case, the Tanzanian government, farmers, buyers, etc.), but also by new users (research companies, consultants, business corporations, etc.) who seek insights from the data. The goal is to create a sustainable platform. In many cases, data is not immediately profitable, and it often takes time to make the decision to pay for and utilize it. In such cases, it is possible to expand the use of data to other users who already understand the value of the data, thereby increasing the number of stakeholders who utilize the data and building a platform that circulates the value of the data, resulting in a sustainable co-creation platform. Although this idea is very different from the conventional business model of building a single platform for a single user, the new business model of a co-creation type data platform has significant advantages and is worth considering.

3.5.5 PoC implementation (financial sector)

(1) PoC Overview

In rural Tanzania, while there are many farmers, the percentage of the population with access to finance tends to be low at 48%, compared to 72% in urban areas. The reasons for this include the fact that many farmers are unable to provide some form of collateral while existing financial institutions require customers to do so, low financial literacy in rural areas, and lack of infrastructure to access financial services.

Therefore, in this PoC, we customized HAKKI AFRICA's credit scoring system, which is specialized for emerging countries, for Tanzanian farmers, and worked with local financial institutions to confirm its usefulness.

The goal of this PoC was to customize HAKKI AFRICA's credit scoring system for rural Tanzanian farmers, to identify the data needed to improve access to finance, and to confirm whether the scoring system could be evaluated as useful by local financial institutions as a decision aid for lending to new customers.

➢ A system that allows people without smartphones or internet access to borrow

➢ Use of ultra-small amount collection (automatic repayment bookkeeping system)

➢ Capable of automatically reminding customers of their balance

➢ Use of credit score system

➢ Financial education and in-depth communication skills for customers (education for local operation staff)

The types of data to be input into the credit scoring system to be developed are as follows

➢ Crop type

➢ Fixed payment amount

➢ Fixed income

➢ Yield data

➢ Social characteristics

➢ Length of service

➢ Mobile money usage data

The expected results (KPI) were set as follows. First, the data necessary to measure credit scores from 100 agricultural workers will be obtained. In addition, a credit scoring system will be developed during the demonstration period. The credit scoring system will automatically display the borrowing limit, rank the customers in five levels, and display the risk analysis when the customer information is entered.

(2) Results

Briefing sessions were conducted in Lushoto and Moshi on May 5 and 7, 2021 respectively to explain and recruit farmers for the loan. The number of participants in each session, the number of loan applications received, the number of applications passed are as follows.

Table 3-23   Number of participants to the briefing sessions

	Lushoto (May 5th)	Moshi (May 7th)
Number of participants to the briefing session	79	65
Number of applications received	79	64
Number of applications passed	25	25

Source: Report by HAKKI AFRICA

Figure 3-61   Briefing session

Source: Report by HAKKI AFRICA

Through the above-mentioned briefing sessions, 143 pieces of data necessary for customizing the credit scoring system were collected, exceeding the target of 100 pieces. Based on this data, a credit scoring system was developed to assess the repayment potential of farmers in rural areas with limited access to finance, and loans of approximately 10,000 yen per person were provided to 25 people in each region and 50 people in total through a local financial institution (Inspired Microfinance). The credibility of the collected data was confirmed by JICA TANSHEP experts, who provided advice on the handling of yields and units.

For the credit scoring system, data on the usage rate of mobile money services such as M-Pesa and Tigo-Pesa was obtained, and it was confirmed that the data on fixed income and fixed payment, which is necessary for customer credit scoring, could be obtained. In addition, we asked a local expert (Dr. Marwa) and a local financial institution (Inspired Microfinance) to conduct an independent evaluation of the algorithm of the credit scoring system. The evaluation was relatively positive. Specifically, a local expert (Dr. Marwa) gave the system a score of 67 out of 100, saying, "It helps farmer groups to access finance and know their income and net worth. It also increases transparency and allows farmers to make an informed decision on whether or not to take out a loan". Inspired Microfinance stated "This analysis system will add a new dimension to our operations. However, other parameters also need to be analyzed, so it is best practice

to combine the analysis of both the system and existing evaluation methods in order to acquire more good customers" and gave the system a score of 67 out of 100.
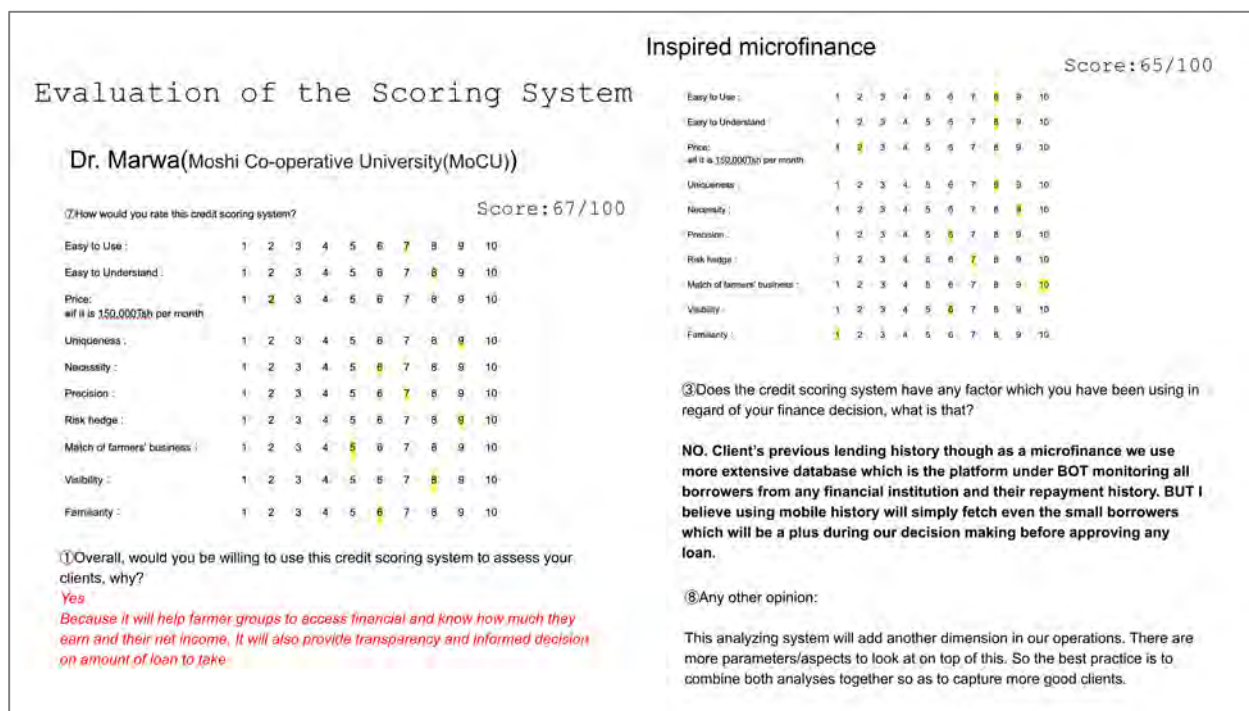
Figure 3-62   Third-party system evaluation results

The actual repayment is expected to take place after January 2022.

(3)   Post-implementation deployment plan

From the beginning of the PoC, HAKKI AFRICA envisioned the private sector's independent development after the implementation of this PoC. Through the actual PoC, HAKKI AFRICA was able to confirm that access to finance is an issue for Tanzanian small-scale farmers, as they often do not have the necessary investment funds on hand to expand farmland and improve yields, and that the credit scoring system is useful. Therefore, we plan to work with local partners to establish a system that can provide small-scale financing, while considering the use of financial assistance from the Japanese government and international organizations. In the initial stage, the company will not obtain a local financial license, but will use the credit scoring system (including the mobile money statement analysis tool) as its main product to enter the market in partnership with local financial institutions, and will consider establishing a local subsidiary in the medium to long term.

In Tanzania, as far as we have been able to ascertain, there is no competition for mobile money statement analysis tools, but in Kenya, SPINMOBIE is ahead of the competition. HAKKI AFRICA differentiates itself from SPINMOBILE's service by pointing out that the latter service has limited automation and takes several hours to measure credit scores. HAKKI AFRICA's service is differentiated from SPINMOBILE's service by the fact that it takes several hours to measure the credit score and the latter blacklists the subject, while HAKKI AFRICA's service enables financial access depending on the subject's efforts.

In Moshi, the target area of this PoC, there are many floods and unpredictable weather conditions, and there is a risk that the crops will not be harvested as predicted, resulting in uncollectible debts. Within this PoC,

we have obtained data on annual yields and neighboring microfinance institutions, so we will assume this risk and hedge the risk by adjusting the interest rate and repayment period from the initial state. In addition, although there is a risk of default by the repayers, studies have shown that the more rural the area, the more likely they are to repay the loan, even if it takes longer, so HAKKI AFRICA is considering adding a margin for delayed repayment to the cash flow calculation.

If the use of the credit scoring system developed in this PoC is expanded, it is expected that local financial institutions will improve the cost and processing speed of loans to small-scale farmers, which will result in increased lending to small-scale farmers and contribute to improved access to finance and financial literacy.

(4)   Lesson learned and others

HAKKI AFRICA's credit scoring system refers to past transaction history (PDF data), so farmers need to obtain their own statements periodically or when taking out loans. At the time of PoC implementation, it took time to communicate the method of obtaining statements and to negotiate the costs involved. In the future, it will be necessary to develop a manual on how to obtain the details, and to investigate how to obtain the details easily by e-mail as in Kenya.

The feedback from the farmers who received the loans was that 10,000 yen is less than other loan/credit programs, and that it would be desirable to provide the loans according to the farming season.

Credit scoring is a decision aid for lenders, and does not guarantee 100% repayment rates. However, it is very useful as a decision-making tool, and has the potential to reduce human errors such as bookkeeping errors, provide supplementary evidence of credit information for small-scale farmers, and contribute to lowering interest rates in Africa, which currently remain high.

As shown by the widespread use of mobile money in Kenya, the same type of service can spread explosively within a certain region, and mobile money can make a significant contribution to achieving financial inclusion. However, the loan services provided by the current mobile money operators have many users due to their ease of use, but with insufficient financial education, there is a risk of increased defaults and the seizure of all future deposits in the event of default. Small-scale farmers should be warned not to take out loans without knowledge, including microcredit services, as well as loan and lending services should be combined with adequate financial education.

Through this PoC, it was confirmend that the credit scoring service developed by HAKKI AFRICA is useful to some extent in resolving the lack of financial inclusion in rural areas of Tanzania. On the other hand, there are many challenges for Japanese small businesses entering the Tanzanian market, such as regulations, business risks, information gathering, etc. Accordingly, the Japanese government's supports from JICA, the Ministry of Foreign Affairs, the Ministry of Economy, Trade and Industry and JETRO for Japanese companies entering the Tanzanian market are valuable. We believe that it is important that government agencies to continue to provide such support and that companies effectively take advantage of these supports.

3.6 Mozambique

3.6.1 Theme Setting

As described in Chapter 2, the team focused on two areas in Mozambique: education and agriculture. Due to the spread of the new coronavirus infection, the field survey, originally scheduled for March 2020, was postponed and then cancelled. From June to August 2020, questionnaire surveys and remote interviews were conducted with JICA project experts, government agencies, donors, local incubators, and others related to education and agriculture.

Questionnaire surveys and interviews were conducted by the following organizations. OI themes were examined based on the information of the companies that conducted OI theme-related questionnaire surveys and interviews, and the companies that conducted STI theme-related questionnaire surveys were asked to cooperate in informing the companies in the network, etc. at the start of call for proposals.

Table 3-24   Parties conducting questionnaire surveys and hearings (Mozambique: OI Theme Relations)

	Category	Survey Location	Method of Implementation
1	JICA Project (Education)	Specialist in "New Curriculum Extension Project at Elementary Teacher Training Schools (IFP)"	Interview
2	JICA Project (Agriculture)	Nacala Corridor Agriculture Development Experts	Interview
3	JICA Project (Agriculture)	Specialist in "Zambezia Rice Productivity Improvement Project"	Interview
4	Government (Education)	Ministry of Education & Human Development	Questionnaire + Interview
5	Government (Agriculture)	Ministry of Agriculture & Rural Development	Questionnaire
6	Government (Agriculture)	Agricultural Research Institute of Mozambique (IIAM)	Questionnaire + Interview
7	Donor (Education)	KOICA	Questionnaire
8	Donor (Education)	GIZ	Questionnaire + Interview
9	Donor (Agriculture)	WFP Mozambique	Questionnaire
10	Donor (Agriculture)	FAO Mozambique	Questionnaire
11	Donor (Agriculture)	IFAD Mozambique	Questionnaire
12	Government (STI)	Ministry of Science and Technology, Higher and Technical Vocational Education	Questionnaire

Source: JICA Survey Team

Table 3-25   Recipients of questionnaire surveys (Mozambique: STI relations)

	Category	Survey Location	Method of Implementation
1	Incubator/Accelerator	Moz Innovation Lab	Questionnaire
2	Incubator/Accelerator	ideiaLab	Questionnaire
3	University	Eduardo Mondlane University	Questionnaire

Source: JICA Survey Team

The outline of the survey results is as follows. The subjects were sorted out, and OI theme options were grouped, and the possibility of OI implementation was examined for each OI theme candidate.

Table 3-26　OI Theme Options Grouping (Mozambique: Education)

	Themes	Opinion on the Issues	Source
1	[Subjects related to class and school management] Insufficient collection, sharing, and dissemination of information on classes and school management	✓ The research team created a lesson analysis tool (Excel Macros) and conducted ST analysis (Activity Distribution of Students and Teachers). We wish to create an app which was not possible due to time constraints. The Education Ministry is conducting other monitoring activities, such as handing out forms and having people fill out the forms. ✓ The people in the Ministry of Education are not aware of the reality of the classes.	JICA expert
		✓ Need to improve communication ✓ Need to improve M & E and reporting systems	MINEDH
		✓ Teachers leave without taking over, so knowledge cannot be transmitted. ✓ Population pressures on systems (Percentage of teachers and students, number of classrooms, etc.)	GIZ
2	[Teacher Issues] Limited of teaching methods and basic abilities of teachers	✓ The teacher's ability is low which leads to the low level of graduates from teacher training schools ✓ There is no interaction between student and teachers during classes	JICA expert
		✓ Teacher's poor basic ability ✓ Lack of human resources (both in number and ability) ✓ High teacher and supervisor absenteeism	GIZ
3	[Issues related to students] Low student achievement and high dropout rates	✓ As a result of ineffective teaching methods, 60% of students are falling behind. Teachers' abilities and minds are different from those in Japan.	JICA expert
		✓ Poor student learning ✓ High dropout rate	GIZ

Source: JICA Survey Team

Table 3-27　OI Theme Option Review (Mozambique: Education)

	OI Theme Candidates (Local partner candidates in parentheses)	Source	Points of OI feasibility study				Points of Attention
			Relations with OI	Feasibility under COVID-19	Appeal to applicants	External factor	
1	Solutions for improving the collection, management, and utilization of information related to classes and school management (Partner: assume IFP)	JICA expert, MINEDH, GIZ	○ Widening the scope of information acquisition and utilization	△ Depending on the availability of local partners	○ GIGA School is flourishing in Japan	△ Attention should be paid to the acquisition and handling of information	By expanding the scope of information acquisition and utilization methods, the theme will be suitable for OI. However, since personal information may be handled, it is important to have close contact with local partners.
2	Solutions for improving teaching methods and basic abilities of teachers (Partner: assume IFP)	JICA expert, GIZ	△ Content is more important	△ Depending on the availability of local partners	△ Existing e-learning providers, but with language barriers	△ Internet environment	Content will be more important than solutions, making open proposals less meaningful
3	Solutions to Improve Student Achievement (Partner: assume IFP)	JICA expert, GIZ	△ Content is more important	△ Depending on the availability of local partners	△ Existing e-learning providers, but with language barriers	△ Internet environment	Content will be more important than solutions, making open proposals less meaningful

Source: JICA Survey Team

Table 3-28　OI Theme Candidate Grouping (Mozambique: Agriculture)

	Themes	Opinion on the Issues	Source
1	Agricultural statistics are inaccurate	✓ Statistics are not in place and there is no basic information. The data on crop acreage and yield are politically sensitive and inaccurate.	JICA expert
2	Low crop prices	✓ Since information on the purchase price is not exchanged between farmers, farmers cannot compete with brokers. If farmers can exchange information, they will be able to negotiate with brokers.	JICA expert
		✓ Crop prices are low ✓ Farmers' limited market access: Buyer's buyback price drops in remote locations ✓ Farmers are not organized and asymmetries may be exploited where farmers do not have market price information ✓ Farmers are isolated and do not know how to negotiate	IIAM
		✓ The impact of COVID-19 is expected to disrupt supply chains and adversely affect small farmers' prices. Therefore, the production and commercialization of small-scale farmers are urgently required.	IFAD
3	Lack of financial access	✓ It is also difficult for banks to access farmers. The bankers go to the farmers to decide whether they can lend money, but the amount is not enough for the farmers. For these reasons, farmers have few means of borrowing money. In order to improve the efficiency (by remoteness) of this part from the front of the corona, it is desirable to have a tool capable of improving access to finance.	JICA expert
4	Diffusion of farmers makes it difficult to spread agricultural technology	✓ Dispersed farmers make it difficult to deliver the technology developed by IIAM to many beneficiaries	IIAM
5	Lack of IIAM internal management systems	✓ No comprehensive monitoring system within IIAM to manage project progress and state of the art ✓ Lack of comprehensive systems for revenue monitoring and inventory management	IIAM
6	Lack of seed traceability	✓ Lack of traceability system to prevent seed forgery ✓ Lack of systems to predict seed demand and platforms to connect seed producers and consumers	IIAM
7	Insufficient maintenance capacity of laboratory equipment	✓ Inadequate management of laboratory equipment (Laboratory equipment, analytical equipment, nitrogen measuring instruments, meteorological observation equipment)	IIAM

Source: JICA Survey Team

Table 3-29　OI theme candidate review (Mozambique: Agriculture)

	OI Theme Candidates (Local partner candidates in parentheses)	Source	Points of OI feasibility study				Points of Attention
			Relations with OI	Feasibility under COVID-19	Appeal to applicants	External factor	
1	Solutions for Yield Forecasting (Partner: TBD)	JICA Expert (RDI)	○ A variety of methods can be considered	△ Technically possible, but requires a partner	○ A variety of methods can be considered	△ Need to get the government's understanding	Yield forecasts may negate traditional agricultural statistics and create conflicts
2	Solutions that contribute to the collection and sharing of agricultural prices (Partner: TBD)	JICA experts (RDI), IIAM, IFAD	○ A variety of methods can be considered	△ Technically possible, but requires a partner	○ A variety of methods can be considered	○ Nothing in particular.	This theme is under consideration at TANSHEP in Tanzania
3	Solutions for Improving Financial Access in Rural Areas (Partner: TBD)	JICA Expert (NTC)	○ A variety of methods can be considered	△ Technically possible, but requires a partner	○ A variety of methods can be considered	△ financial regulations, depending on the content	
4	Solutions that contribute to the diffusion of technologies to dispersed farmers (Partner: IIAM)	IIAM	○ A variety of methods can be considered	△ Depends on the cooperation of IIAM	○ A variety of methods can be considered	○ Nothing in particular.	IIAM conducted a demonstration using SMS last year and is currently evaluating it.
5	IIAM Solutions for Improving Internal Management Systems (Partner: IIAM)	IIAM	△ normal BPR	△ Depends on the cooperation of IIAM	△ The appeal as OI theme is low.	○ Nothing in particular.	
6	Solutions for improving seed traceability (Partner: IIAM)	IIAM	○ A variety of methods can be considered	△ Depends on the cooperation of IIAM	○ A variety of methods can be considered	△ Participation of seed producers	IIAM only licenses seeds, so tracing requires operational improvements
7	Solutions for improving the maintenance capability of laboratory equipment (Partner: IIAM)	IIAM	○ A variety of methods can be considered	△ Depends on the cooperation of IIAM	○ A variety of methods can be considered	○ Nothing in particular.	Support or content can be used to implement OIs in conjunction with other country themes

Source: JICA Survey Team

As a result of the examination of the above OI theme options, in the field of education in Mozambique, two candidates were selected: "A solution for visualizing student information that facilitates the communication of information between teachers and contributes to the improvement of student performance and attendance." and "Solution for visualizing behavior data of teachers and students that contributes to measuring and improving the effectiveness of classes". As a result of discussions with the Mozambique Office and the Human Development Department, there are concerns about the feasibility of the former, as

it places a heavy burden on school teachers and some systems are not used by other donors. On the other hand, in the case of the latter, the current situation is that it takes about three months to analyze a one-hour class. The final decision was made on the OI theme of "Innovation for visualizing and analyzing the behavior and speech of teachers and students in order to contribute to the improvement of classes at teacher training schools" to broaden the scope of data to be obtained.

The agricultural sector in Mozambique was finally excluded from the OI theme because the timeline of the public offering in the OI did not match the project of the partner.

3.6.2 Call for Solutions

A public relations and registration website was set up for this event. The following is an excerpt from the public offering.

CHALLENGE

'Technologies to Visualize and Analyze Behavior/Utterances of Teachers and Students During Lectures in Teacher Training Institutes'

(Examples of possible solutions)

- Image and voice processing techniques that can automatically measure indicators based on the video footage or sensor data

BACKGROUND

JICA implemented the Project for Expansion of New Curriculum of Teacher Training Institute (IFP), a technical cooperation project, in Mozambique from April 2016 to April 2020. It is pointed out that the quality of teacher performance in Mozambique should be improved because the achievement level of children's academic ability in primary education is not sufficiently high. To improve classes, it is essential to objectively understand teacher's behavior/questions and student's answers/utterances, identify problems, and improve teaching methodology.

As math and science teaching in Japan is well known for its high quality, JICA's Project for Expansion of New Curriculum tackled to improve the math and science instruction ability of IFP students by developing, testing, and introducing math and science teaching materials for IFP students. Simultaneously, class videos were analyzed using the S-T analysis system to visualize classes. This allowed the teacher who had conducted the class to become focused on student-centered lessons, gradually emphasizing on student participation.

JICA promotes discussion for future project expansion to facilitate teachers and students to efficiently and effectively acquire knowledge and techniques for improving the class. This RFP calls for solutions that can visualize and analyze the behavior and utterances of teachers and students, and give feedback or support to teachers.

WHAT PARTICIPATE

■ JICA will provide PoC opportunity (Expected to be conducted in JICA's teacher training institutues)

■ JICA will provide Proof of Concept (PoC) opportunity by providing the PoC fund of up to 3~5 million yen

■ If the PoC is successful, there are possibilities for technologies/services to be introduced in JICA projects

■ JICA will support the PoC by introducing the government agencies and public institutions in the country

POINTS TO CONSIDER

- Internet access situation: LTE network is available in Mozambique including IFP, but internet speeds are slow in some areas. Wireless LAN environment is unavailable in IFP buildings.

- Among the IFP teachers, 80–90% use smartphones.

- Line speed is unmeasured.

PoC

- PoC Period：Approximately 3 months within Feburary to June 2021

- PoC will be conducted remotely in case of travel constraints due to COVID-19

- PoC location: School building of IFP in Matola, Maputo Province

- Number of users: It is to be decided depending on the proposal. The project supported 6 teachers (3 for math, 3 for science education and 400 students (170 new trainees in 2017, 110 in 2018, 120 in 2019).

- As the indicators for quantitative analysis are open, proposals such as the following are welcome: Content of teacher's question, content of student's answer, writings on black/white board, frequency and length of teacher's utterance, frequency and length of student's utterance, behavior and actions of teachers and students.

- Communicative language: Standard language is Portuguese. When an interpreter is required during the demonstration, related costs can be included in the PoC budget. As English is not used for communication, it is desirable to use Portuguese in software and other solutions.

Project for Expansion of New Curriculum of Teacher Training Institute (IFP)

- Project: Technical Cooperation

- Challenges: Education

- Duration: April 2016 - April 2020 (Completed. Currently implementing a subsequent project, " Project for Expansion of New Curriculum".)

- Business Completion Report: https ://, libopac.jica.go.jp/images/report/P 1000043318 .html

- Summary:

In Mozambique, the achievement level of children's academic ability in primary education is not sufficiently high. The Ministry of Education and Human Development (MINEDH) indicates that the quality of teacher performance in the country should be improved. Given this background, the teacher training system started in 2007. However, its 1-year training program was identified as not adequate for developing high expertise and practical skills as a teacher. This project plans to develop and test math and science teaching materials for IFP students by transferring Japan's accumulated experience in math and science education. This will contribute to improving the math and science teaching ability of IFP students.

[Case Study: Lesson Effects Measurement "S-T analysis tool"]

出典：実際のIFP授業に基づきプロジェクトチーム作成
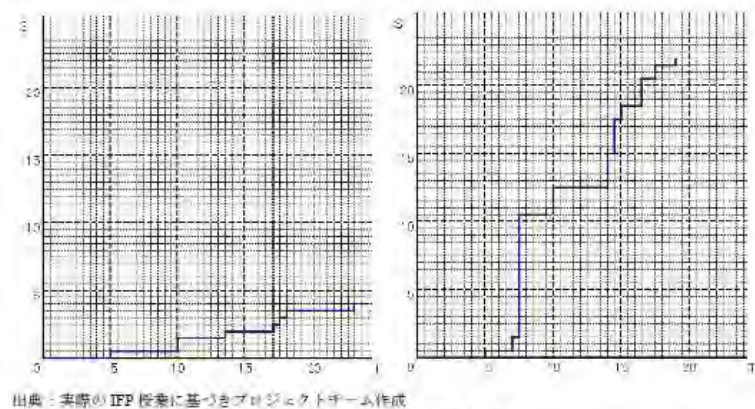
- In this project, we discussed with MINEDH, a counterpart organization, what kind of activities we wanted to record, referring An excel macro program was developed after discussion with MINEDH, the counterpart of the project, about what kind of activities to be recorded by reference to S-T analysis system used in Japan.

- In above chart, the vertical axis shows student's activities (same as students who play school children in mock class) while the horizontal axis shows instructor's activities (same as students who play instructors). The left figure includes classes with more instructor-centered activities while the right includes classes with more student-centered activities.

- Although it is insufficient to assess the class with only this system, even a person without knowledge of subject or teaching method can easily judge whether the class is a one-sided lecture by a teacher or a student participation-based class using this system.

- After repeated guidance on the system in the training course, monitoring or investigation found that employees of government and other public offices, the directors of IFPs, etc. had become to discuss and analyze practical classes. Moreover, the visualization of classes made teachers become aware of student-centered lessons, gradually changing classes from lecture- to student participation-based.

3.6.3 Screening Result

(1) Applicants

A total of 5 companies from 3 countries - Japan, Mauritius and India - applied (In addition, only 2 documents were submitted.). All the applicants were venture companies. [*]5Two of the applications were in-class speech analysis, two were video analysis, and one was facial expression analysis.

(2) Results

A review was conducted based on the review criteria described above, and three companies passed the primary review and an online interview was conducted. The purpose of the online interview was to improve the solution and demonstration plan by deepening the understanding of both the JICA side and the applicant company side and especially deepening the understanding of the field needs and the field situation by the applicant company side, and to have them participate in the final examination.

As a result of the review, Hyllable Co., Ltd., a Japanese venture company, was adopted, which proposed to analyze the utterances of teachers and students using an egg-shaped device equipped with a directional microphone and provide feedback using a worksheet based on the analysis results.

3.6.4 PoC Implementation

(1) PoC Overview

➢ Objectives

This PoC was conducted to analyze and visualize the lessons in order to promote a change from lecture-based to learner-centered teaching in the classes of a primary teacher training school (IFP) in Mozambique. Conventional S-T analysis tools (tools that compare and analyze the amount of speech between teachers and students) have had problems such as manual data entry, which makes feedback time-consuming and makes it difficult to expand the project, and inability to listen to all the speech of teachers and students, which makes detailed class analysis difficult. Therefore, in this PoC, we used Hylable Discussion system (an egg-shaped IoT microphone that records conversations), which can visualize and analyze discussions in class automatically, to demonstrate the effects of quantitative class analysis through visualization of discussions. We also developed operations that can be implemented in schools in Mozambique.

➢ Specifications of Hylable Discussion system

- 8 omni-directional microphones, 8 LEDs, small speaker
- External mobile battery powered

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5 (* Definition of classification) Large enterprises: enterprises with capital of 50 million yen or less/100 employees or less in the information service industry, and capital of 300 million yen or less/300 employees or less in the manufacturing industry. Venture enterprises: establishment of 10 years or less/development of new businesses

- Control board Raspberry Pi 3B (Wi-Fi connection (2.4GHz))

- Automatic upload + automatic analysis based on seat position (seat can be set afterwards)

- When there is a Wi-Fi connection, recording can be done from a browser. Remote control of local microphone is also possible from Japan.

- When there is no Wi-Fi connection, recording can be done with a physical button on the microphone, and upload and analysis can be done automatically when connected to the network afterwards.
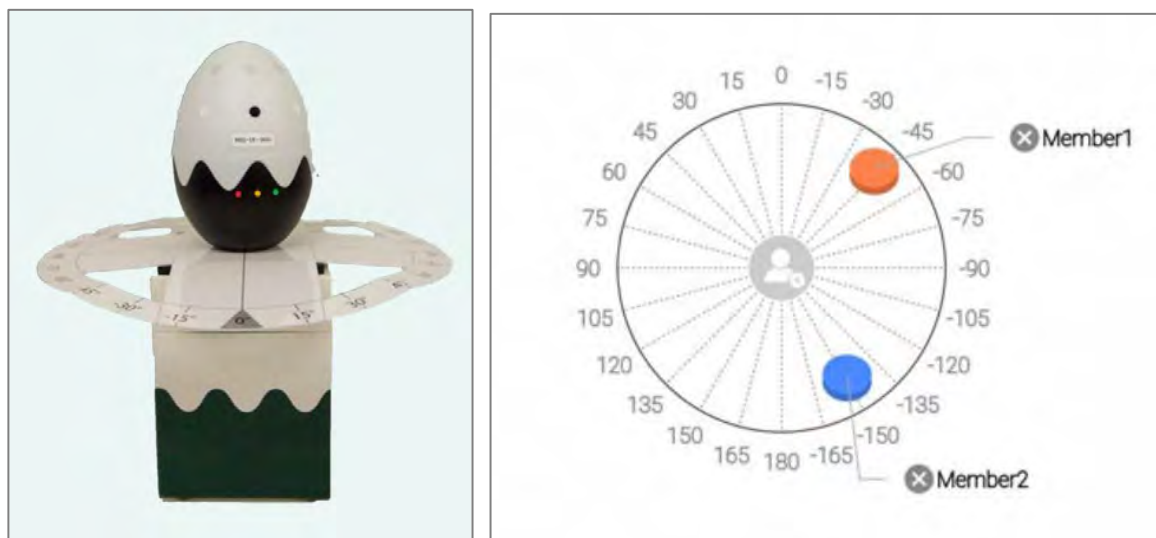

Figure 3-63   Eggshell recorder and seat setting UI

The main functions of the egg-type recorder are individual discussion and visualization of the accumulated data of groups and individuals. For individual discussions, it can analyze temporal changes in the amount of speech, turn-taking, and individual behavioral analysis (amount of speech, overlap, and excitement), while for group and individual accumulation, it can analyze changes in the entire group, distribution of each student's behavior, and individual behavioral changes.

The purpose of this PoC, in which Hylable Discussion is used multiple times in actual classes at a teacher training school (IFP), is to verify the effectiveness of education at the IFP through the promotion of metacognition through data reflection, analysis of the effectiveness of facilitation by teachers, and feedback, as well as to verify the feasibility of the operation method in Mozambique.

The main KPIs for this PoC were set as follows.

➢ Verification of educational effectiveness in teacher training schools

- Qualitative verification: Faculty and student surveys and interviews: Visualization is effective in changing behavior and awareness

- Quantitative validation: Before/after comparison of student evaluations: More than 50% of student evaluations will improve

➢ Feasibility study on how to operate in Mozambique

- Conduct mock classes in a noisy classroom, network environment, and class format: Establish procedures and create manuals for teachers and students to use self.

- UI and reports translated and modified to meet needs: User interface built that over 70% want to use.

The initial schedule for this PoC is as follows. The demonstration was postponed due to the lockdown caused by the outbreak of the new corona infection, and as a result, it was extended until the end of October.

Table 3-30   Schedule for PoC implementation in Mozambique

	Before demonstration	April 2021	May 2021	June 2021
Technical verification		Translation of UI and reports into Portuguese	Improvement of UI and reports	
Educational verification		Briefing on usage, test recording	Mock class recording	Operation improvement
Others	Pre-arrangement of recorders	Shipment	Interviews and questionnaires	Summary of results Preparation of operation procedures Preparation of final report

As mentioned above, the demonstration was postponed due to the effects of the lockdown caused by the outbreak of the new coronary disease, and overall, three discussions were recorded in two classes for a total of 74 students for a total of 4.5 hours. Note that students in math class and students in science class do not overlap.A summary of the implementation is as follows.

Figure 3-64   PoC Implementation Overview

(2)   Results

Verification of educational effects (qualitative verification): In the classes at IFP, it was confirmed that the provision of visualization data using Hylable Discussion transformed the behavior and awareness of both faculty and students. For the instructors, the visualization of the discussions showed that they were motivated to "learner-centered teaching" to increase the amount of student speech by reducing the amount of intervention by the instructors themselves by knowing the behavioral changes of the students. On the other hand, for the students, the feedback of the analysis results gave them an opportunity to compare their own impressions of the discussion with the data and to metacognize their own behavior.

Verification of Educational Effectiveness (Quantitative Verification): Through the PoC, it was confirmed from the analysis of the students' speech data that the whole process became more active and even. Comparison of the evaluations to the students was not conducted due to the small number of recordings.

In the classes where feedback was given, behavioral changes were observed in the form of (1) an increase in the amount of speech by students who had been particularly low in the amount of speech, and (2) an increase in the amount of overlap among the members.

In addition, through multiple PoC sessions, discussions became more active (average: 1.49 times) in all groups of the mathematics class where feedback was given, while there was no significant change in activity in the science class where no feedback was given. This confirms that the feedback resulted in a change in the whole group to actively participate in the discussion, such as by ministering.

- **Effects for the Teachers**
  - Discussion visualization improved their motivation for student-centered education.
  - They expected that students would change their mind

- **Effects for the Students**
  - Discussion visualization improved their metacognitive skills

From the questionnaire and interview	From the data analysis of discussions
The feedback improved their motivation to active participation	Their behavior actually changed after the feedback

Figure 3-65   Results of verification

Source: Report by Hylable

Verification of feasibility: In response to the KPI of establishing procedures and creating manuals that teachers and students can use by themselves, we established procedures and created manuals that cover recording and reviewing the analysis results, and were able to implement recording in actual classes using the created procedures and manuals.

Figure 3-66　　　　Images of the PoC

Source: Report by Hylable

In some of the classes where PoC was conducted, there was a problem with portable Wi-Fi on the day of recording, but we were able to conduct recording and analysis without any problems even in an offline state.

With regard to the KPI that more than 70% of the respondents would like to use the user interface, a questionnaire was conducted on the ease of understanding of the graphs and reports of Hylable Discussion and the intention to continue using it (whether they would like to use it again)[6]. The graphs and reports were generally well received by both faculty and students, but some students found the reports difficult to understand. Regarding the intention to continue using the system, 100% of the faculty and students who responded chose "I would like to use it again" or "I would definitely use it again". The main reasons for this were that the manuals and user interface were translated into Portuguese with attention to clarity, the usage instructions were shared with the local assistants beforehand, and they were able to provide detailed explanations on site.

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[6] Since the purpose of this questionnaire was to collect impressions and opinions about the user interface and the usability, the cost of the equipment and services was not explained.
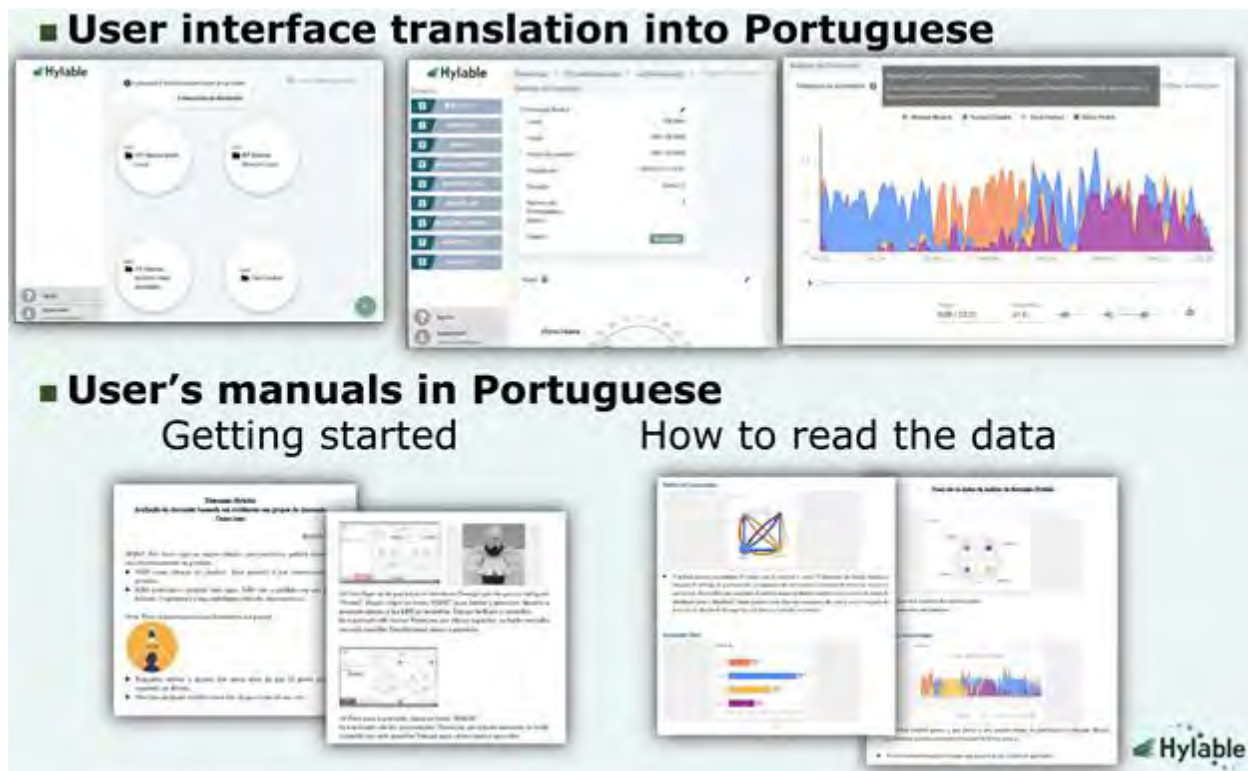
Figure 3-67　　　　Interface and manuals in Portuguese

(3)　Post-implementation deployment plan

It is assumed that the cost of introducing Hylable Discussion, especially the egg-shaped recorder, will be a challenge for educational institutions in developing countries to implement. Therefore, Hylable's deployment plan at the start of the PoC was to implement the costly initial introduction and self-run in cooperation with a project by a donor organization, and after local staffs are trained, conclude a sales agency contract and deploy the system to multiple schools. On the other hand, based on the results of the PoC, JICA appreciated the technology and its effectiveness, but it was difficult to adopt the technology in the technical project mainly due to cost concerns.

Hylable also envisions the use of the system in education-related projects conducted by aid agencies, etc., as a tool to improve educational effectiveness by combining it with educational contents, and as a behavioral measurement tool for quantitative assessment of the project.

(4)　Lessons learned and others

No major problems occurred in the implementation, preparation, and recording of Hylable Discussion, except for the postponement due to the lockdown of the IFP caused by the outbreak of a new corona infection. On the other hand, points to be noted and points that can be improved include the following.

➢　Weak Wi-Fi environment

Since there was no Wi-Fi environment in the IFP, it was necessary to purchase a mobile router. However, the egg-shaped recorder has an offline recording function, and the data can be uploaded and analyzed simply by connecting to the network at a later date. Therefore, even classes that could not be connected to the network due to the failure of the mobile router were successfully recorded and analyzed.

➢ Students' PC/mobile environment

If students have a PC or smartphone connected to the Internet, they can check the analysis results on the spot from their browser, but since there was no such environment for this verification, it was necessary to print and distribute the reports.

➢ Protocol

In the IFP demonstration, it was necessary to obtain the approval of the Ministry of Education first, which resulted in it taking longer than expected to adjust the schedule for the demonstration. In addition, each process of the demonstration required the support of JICA and local collaborators who were familiar with the local situation.

➢ Communication with the Government

With regard to the PoC, we had discussions with the Director General of the Ministry of Education of Mozambique a couple of times, and reported the results and explained the costs. However due to time constraints, we were not able to have concrete discussions on the cost burden and the specific utilization after the PoC. As mentioned above, it is considered difficult to continue the development of this product/service in developing countries by the private sector alone at this stage due to cost constraints, and it would have been appropriate to communicate more extensively with the governments of the countries that will be the users regarding cost sharing and specific utilization after the PoC.

➢ Consideration of multiple options for post-PoC utilization

As mentioned above, at the start of the PoC, the primary plan for post-PoC utilization and development was to collaborate with JICA's projects. However, as a result of the PoC, the above-mentioned collaboration has become difficult, and it is not realistic to continue using the project with the budget of the Ministry of Education of Mozambique. In this regard, it was important to consider multiple options in advance, such as collaboration with other aid agencies, continuation of the project using some other source of funding, and/or securing financial resources from the partner country's government, and to secure them as backups, in order to promptly implement the next best measures when difficulties arise in the initial utilization and deployment plan.

Possible future issues and measures for the deployment and utilization of Hylable Discussion overseas, especially in developing countries, are as follows.

➢ Limitations of online support

In this PoC, we provided support from preparation to recording completely online in order to respond to the new coronary disease. Although there were no major problems, it was difficult to provide detailed tips on how to use the system according to local conditions. As a countermeasure, if Hylable Discussion is to be used continuously in the future, it would be appropriate to visit the site once and provide support and suggestions for further use according to the local conditions.

➢ Necessity of long-term and continuous recording

In this PoC, although we were able to confirm changes in the attitudes of teachers and students even after two recordings, it is thought that the content and transition of behavioral changes can be confirmed in more detail and effectively by using the system for a longer period. As a countermeasure, if we decide to conduct the demonstration again in the future, it would be appropriate to secure a longer demonstration period.

➢ Management of expensive egg-type recorders

The egg-shaped recorders used in this PoC are expensive, costing around 200,000 yen per unit. Normally, when they are used in Japan, they are managed by schools, and in this PoC, they were stored at the JICA Mozambique office during the verification period. For future use, it will be necessary to have a sufficient management system, such as appointing a person in charge of management at an appropriate storage location.

Finally, we would like to examine what technologies and services led to what solutions, and what solutions would be effective in solving the problems in Africa and Mozambique.

In examining and extracting the issues prior to this PoC, interviews were conducted with JICA project experts, government agencies, and donors. As a result, it was concluded that one of the key issues in the education sector in Mozambique was the insufficient collection, sharing, and dissemination of information on classes and school management due to the lack of teacher training that accompanies the rapid increase in the number of students. While this issue is common to many African countries that are facing rapid population growth and a lack of educational resources, this was an area where the use of information through ICT technology was expected to provide a solution.

The low level of teaching methods and basic skills of teachers was also cited as an issue in Mozambique's education, and "teachers talking all the time in class" was pointed out as a specific example. Considering the fact that there is a global trend to encourage a shift from delivery-based lectures (professor-centered paradigm) to student- and learner-centered learning approaches and active learning methods[7], this is an appropriate point regarding teachers' teaching methods. The solutions along this point are likely to be effective not only in Mozambique but also in many other developing countries.

The Hylable Discussion system demonstrated in this PoC is useful for visualizing discussions and promoting a change from lecture-based education to learner-centered education, but it also makes it possible to conduct S-T analysis automatically and quickly, which has been difficult to implement in the past due to the large amount of work and complexity. The system has been evaluated for its reliability and performance, as it has already been used by more than 18,000 people in Japan, mainly in school education and corporate training, and presented at academic conferences.

In light of the above-mentioned educational issues in Mozambique, it was hoped that the use of this technology in teacher training schools would enable an efficient shift to a learner-centered, discussion-based approach to teaching, as well as the visualization of classroom discussions and the collection, sharing, and analysis of information on classroom management. It was also hypothesized that by efficiently training teachers who have learned about discussion-based education, the quality of primary education in the country would improve as a result.

As a result of the actual PoC, it was confirmed that the behavior and awareness of both teachers and students were positively changed to a certain extent, despite the limited demonstration of three classes. As mentioned above, more long-term and continuous use of the system is needed to confirm its effectiveness, but it is thought to have a certain degree of effectiveness as one of the solutions to educational issues in Mozambique, Africa, and developing countries. On the other hand, it should be noted that in developing countries, where labor costs are relatively low, the costs of technologies and services that "reduce manpower and labor" are subject to more stringent scrutiny than in developed countries.

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[7] JICA, Education Knowledge Management Network, "Analysis Report for the Formation of the Teacher Education Sector Case" (2014) (The title is a tentative translation).https://openjicareport.jica.go.jp/pdf/12234464.pdf

Chapter 4 Implementation of Open Innovation (with KOSEN student teams)

4.1 Overview of Open Innovation Implementation

4.1.1 Overview

KOSEN Open Innovation Challenge powered by JICA, in which technical college students with track record in robot development and so on tackled on the challenge by using their imagination and technical skills to solve social issues in Africa, was implemented as a part of "Survey on Open Innovation through utilizing Disruptive Digital Technologies in Africa" in 2019. As a result, the JICA-KOSEN Innovation Platform was established with the participation of National Institute of Technology (NIT), so-called KOSEN, Nagaoka College, Tokuyama College, Kitakyushu College, Sasebo College, and Nagaoka Activation Zone of Energy NAZE.

In 2020, as part of this study, JICA provided a place for open innovation, and implements the JICA–KSOEN Open Innovation Challenge, in which technical college students with track record in robot development and so on tackled on the challenge by using their imagination and technical skills to solve social issues in Africa. In 2020, as in the previous year, the JICA Survey Team collected the problem-solving proposals from KOSEN students on challenges that were discussed with local partners in Africa, and supported prototyping and on-site verification of excellent proposals. The overall flow of this program is as follows. The initial plan was to travel to Africa and hold a prototype demonstration once the spread of the COVID-19 ended, but all the demonstrations were held remotely due to the travel restriction during this survey period.

Preliminary preparation	Sharing of Challenge & Recruiting participants	Pre-study of solutions	Challenge Day (Presentation & Selection)	Brush up & prototyping	JICA Reporting	Follow-up (Including demonstrations)
Mar. to Jun. 2020	Jul. 2020	Jul.-Aug. 2020	Aug. 28/Sept. 11	Sept. to Dec. 2020	Dec. 21, 2020	From Feb. 2021
• Sett Challenges • Adjust schedule with participating colleges	• Distribution of guidelines for the Open Innovation Challenge • Distribution of Challenges and related materials • Recruiting students from participating colleges	• Team formation by students at each college • Group work by each team to elaborate the ideas, plans, and prototypes that will be the solution to the Challenges	• Develop proposal presentation by team • Online presentation, screening and selection of excellent teams (* Due to the school calendar, it was implemented in two dates.)	• Selected teams brush up the proposals with PJ teams and produce prototypes	• Prototype progress report meeting for JICA • The KOSEN teams conducted a prototype demonstration for related parties.	• Product improvements based on feedback from domestic demonstrations • In case of end of COVID-19, on-site demonstration (all remotely as a result) • Final report meeting for JICA held on September 9, 2021

Figure 4-1 Overall Program (JICA-KOSEN Open Innovation Challenge)

Source: JICA Survey Team

4.1.2 Overview of Challenge

In setting the challenge in 2020, the following 3 points were taken in consideration.

✓ It is required to have local partners because of the spread of COVID-19 infection (Japanese companies and JICA project related organizations are assumed as much as possible, because it is not possible to visit the site and confirm the actual conditions of candidates for local collaboration).

✓ In order to conduct a field demonstration of the prototype, a field acceptance system to send the prototype and conduct a demonstration remotely is a prerequisite assuming that a visit to the field is impossible.

✓ In order to conduct domestic demonstrations prior to local demonstrations, it would be even better to have a system to cooperate with domestic demonstrations.

The following four challenges were set as a result of the examination of local partner candidates in the target countries.

Challenge 1: Call for Ideas to Prevent the Spread of COVID-19 Infection Through the Power of Digital Fabrication.
Kenya / Local Partner: Jomo Kenyatta University of Agriculture and Technology
Rwanda / Local Partner: IPRC Thumba
Challenge 2: Call for Ideas for Improving the Productivity and Quality of Paving Blocks Using Waste Plastic!
Ghana / Local Partner: Nelplast Ghana Ltd
Challenge 3: Promoting the Digitization of Rural Areas! Call for Ideas of Radio Wave Map Made and Shared by Everyone!
Mozambique / Local Partner: Nippon Biodiesel Fuel Co., Ltd../ ADM
Challenge 4: Improving Rice Trade Prices! Call for Ideas for a Stone Removing Machine with a Simple Mechanism!
Tanzania / Local Partner: WASSHA Inc.

*It was held at the same time as the "Project to Solve Issues in Africa and Local Region in Japan Through Reverse Innovation Linking the Nagaoka Manufacturing Ecosystem and Africa", and in addition to the challenges mentioned above, Nagaoka College tackled on "Challenge 0: Call for Ideas for a Sustainable Food Production and Supply System for the Realization of a Circular Society!" (Kenya / Local partner: Ecodudu, Japan / Domestic partner: Nagaoka University of Technology / Nagaoka Activation Zone of Energy NAZE).

4.2 Result of Challenge Day (Presentation Review)

4.2.1 Outline of Challenge Day

⑴ Output

The following output for Challenge Day was prepared by each team.

Output: Create and deliver a 5 minute presentation on solutions to the challenge
Presentation is free style. However, the presentation should include the following:.
1. Selected Challenge
2. Understanding of Challenge: Issues and their causes, factors that impede resolution, points of view for resolution, etc.
3. Direction to solve issues and specific products and services (Functions, product images, usage images, expected results, etc.)
4. Prototype Production Plan (Period: September - November) and Budget Required (400,000 yen or less) *Teams selected thereough Challenge Day will receive prototype funding *For the convenience of bringing the prototype to the site, in the case of hardware, it is recommended that the weight should be 10 kg or less and 1 side should not exceed 30 cm (However, this does not apply if assembly and disassembly are possible.).
5. Team Name, Team Member

(2) Selection Criteria

The selection criteria for the Challenge Day were as follows. Each challenge was judged by the judges based on the following criteria.

Table 4-1   Selection Criteria (for Challenge Day)

Criteria	Scoring	Note
Validity	5	The focus of the solution to the Challenge is reasonable?
Feasibility	10	Feasible ideas? Realistic prototyping plans?
Uniqueness	10	Innovative ideas or ingenuity?
Presentation	5	Presentation is understandable? The passion of presenter?

Source: JICA Survey Team

(3) Judges

The judges for each challenge were as follows. Each challenge was reviewed by a local partner or a member of this research team, JICA, and a technical expert.

Table 4-2   Judges (for Challenge Day)

Challenge	Examiners	Affiliation
Challenge 0 (Reverse Innovation Theme limited to Nagaoka College): Call for Ideas for a Sustainable Food Production and Supply System for the Realization of a Circular Society! (Kenya/Japan)	Mr. Keisuke Nakamachi	Secretary General, Nagaoka Activation Zone of Energy NAZE Senior Managing Director, N・S・S Co.,LTD
	Mr. Ken Kubokura	Planning Department, International Aid Planning Office / Innovation & SDGs Promotion Office, Japan International Cooperation Agency (JICA)
	Mr. Masayuki Sakata	Deloitte Tohmatsu Venture Support Co., Ltd.
Challenge 1: Call for Ideas to Prevent the Spread of COVID-19 Infection Through the Power of Digital Fabrication. (Kenya/Rwanda)	Dr. Shohei Aoki	Visiting Associate Professor, Jomo Kenyatta University of Agriculture and Technology / Expert, AFRICA-ai-JAPAN Project
	Mr. Ken Kubokura	Planning Department, International Aid Planning Office / Innovation & SDGs Promotion Office, Japan International Cooperation Agency (JICA)
	Mr. Masayuki Sakata	Deloitte Tohmatsu Venture Support Co., Ltd.
Challenge 2: Call for Ideas for Improving the Productivity and Quality of Paving Blocks Using Waste Plastic! (Ghana)	Mr. Yuki Hata	Representative Partner, Next Technology LLC
	Mr. Ryuichi Kato	General Manager, Africa Department, Japan International Cooperation Agency (JICA)
	Ms. Minako Sagara	Innovation Production Department Policy and Regional Innovation Unit, Deloitte Tohmatsu Venture Support Co., Ltd.
Challenge 3: Promoting the Digitization of Rural Areas! Call for Ideas of Radio Wave Map Made and Shared by Everyone! (Mozambique)	Mr. Shun Sato	Nippon Biodiesel Fuel Co., Ltd. / ADM
	Mr. Yuki Hata	Representative Partner, Next Technology LLC
	Mr. Ryuichi Kato	General Manager, Africa Department, Japan International Cooperation Agency (JICA)
Challenge 4: Improving Rice Trade Prices! Call for Ideas for a Stone Removing Machine with a Simple Mechanism! (Tanzania)	Mr. Carlos Oba	New Business Incubation, WASSHA Inc.
	Mr. Yuki Hata	Representative Partner, Next Technology LLC
	Mr. Ryuichi Kato	General Manager, Africa Department, Japan International Cooperation Agency (JICA)

Source: JICA Survey Team

(4) Schedule

Due to the school calendar, the Challenge Day was divided into 2 days, and was held on August 28, 2020 fpr Nagaoka College (13 teams) and Tokuyama College (1 team), and on September 11 for Kitakyushu College (5 teams) and Sasebo College (1 team) online (Microsoft Teams). Each team had 5 minutes on presentation, 3 minutes on Q&A, and 2 minutes on buffer. The review schedule was as follows.

Table 4-3   Challenge Day 1 (August 28, 2020)

Time	Teams meeting 1		Teams meeting 2	
	Contents	Judges/Moderator	Contents	Judges/Moderator
15:30-15:40	Explanation of purpose and introduction of judges	Moderator: Mr. Sakata (Tohmatsu)	Explanation of purpose and introduction of judges	Moderator: Ms. Sagara (Tohmatsu)
15:40-15:50	Challenge 0: Nagaoka College Team 0 -1	1. Mr. Nakamachi, NAZE 2. Mr. Kubokura, JICA 3. Mr. Sakata, PJ Team	Challenge 2: Nagaoka College Team 2 -1	1. Mr. Hata, Next Tech 2. Mr. Kato, JICA 3. Ms. Sagara, PJ Team
15:50-16:00	Challenge 0: Nagaoka College Team 0 -2		Challenge 2: Nagaoka College Team 2 -2	
16:00-16:10	Challenge 0: Nagaoka College Team 0 -3		Challenge 3: Nagaoka College Team 3 -1	1. Mr. Sato, NBF 2. Mr. Hata, Next Tech 3. Mr. Kato, JICA
16:10-16:20	Break		Challenge 3: Nagaoka College Team 3 -2	
16:20-16:30	Challenge 1: Nagaoka College Team 1 -1	1. Dr. Aoki, JKUAT 2. Mr. Kubokura, JICA 3. Mr. Sakata, PJ Team	Challenge 4: Nagaoka College Team 4 -1	1. Mr. Carlos, WASSHA 2. Mr. Hata, Next Tech 3. Mr. Kato, JICA
16:30-16:40	Challenge 1: Nagaoka College Team 1 -2		Challenge 4: Nagaoka College Team 4 -2	
16:40-16:50	Challenge 1: Nagaoka College Team 1 -3		Challenge 4: Tokuyama College Team 4 -1	
16:50-17:00	Comments from the judges (2 minutes/person)	Moderator: Mr. Sakata (Tohmatsu)	Comments from the judges (2 minutes/person)	Moderator: Ms. Sagara (Tohmatsu)
17:00-17:10	Closing (→ Challenge 0 judges will move to another Teams meeting)		Closing	
17:10-17:20	Challenge 0: Nagaoka College Team 0 -4			
17:20-17:30	Judges tabulate and evaluate Challenge 0	Moderator: Mr. Sakata (Tohmatsu) Judges: Challenge 0		

Source: JICA Survey Team

Table 4-4   Challenge Day 2 (September 11, 2020)

Time	Teams meeting	
	Contents	Judges/Moderator
15:30-15:40	Explanation of purpose and introduction of judges	Moderator: Mr. Sakata (Tohmatsu)
15:40-15:50	Challenge 1: Kitakyushu Technical College Team 1 -1	1. Dr. Aoki, JKUAT 2. Mr. Kubokura, JICA 3. Mr. Sakata, PJ Team
15:50-16:00	Challenge 3: Kitakyushu Technical College Team 3 -1	1. Mr. Sato, NBF 2. Mr. Hata, Next Tech 3. Mr. Kato, JICA
16:00-16:10	Challenge 2: Kitakyushu Technical College Team 2 -1	1. Mr. Hata, Next Tech 2. Mr. Kato, JICA 3. Ms. Sagara, PJ Team
16:10-16:20	Challenge 2: Kitakyushu Technical College Team 2 -2	
16:20-16:30	Challenge 4: Kitakyushu Natl. Coll. of Technology 4 -1	1. Mr. Carlos, WASSHA 2. Mr. Hata, Next Tech 3. Mr. Kato, JICA
16:30-16:40	Challenge 1: Sasebo Technical College Team 1 -1	1. Dr. Aoki, JKUAT 2. Mr. Kubokura, JICA 3. Mr. Sakata, PJ Team
16:40-16:50	Comments from the judges (2 minutes/person)	Moderator: Mr. Sakata (Tohmatsu)
16:50-17:00	Closing (Judges take a break)	-
17:00-18:00	Adoption conference in separate Teams (10 minutes for aggregation, and about 10 minutes for selection for each challenge)	Moderator: Mr. Sakata (Tohmatsu)

Source: JICA Survey Team

4.2.2   Result of the Presentation Review

A total of 20 teams and 101 people from 4 colleges participated in the Challenge Day. The breakdown was as follows.

Table 4-5 Participating Teams on Challenge Day

challenge	Nagaoka (Review 8/28)	Tokuyama (Review 8/28)	Kitakyushu (Review 9/11)	Sasebo (Review 9/11)	Total Nr. of Teams
Challenge 0 (Reverse Innovation Theme limited to Nagaoka College): Call for Ideas for a Sustainable Food Production and Supply System for the Realization of a Circular Society! (Kenya/Japan)	4 teams (22 students)	–	–	–	**4 teams (22 students)**
Challenge 1: Call for Ideas to Prevent the Spread of COVID-19 Infection Through the Power of Digital Fabrication. (Kenya/Rwanda)	3 teams (18 students)	–	1 team (7 students)	1 team (3 students)	**5 teams (28 students)**
Challenge 2: Call for Ideas for Improving the Productivity and Quality of Paving Blocks Using Waste Plastic! (Ghana)	2 teams (10 students)	–	2 teams (6 students)	–	**4 teams (16 students)**
Challenge 3: Promoting the Digitization of Rural Areas! Call for Ideas of Radio Wave Map Made and Shared by Everyone! (Mozambique)	2 teams (13 students)	–	1 team (3 persons)	–	**3 teams (16 students)**
Challenge 4: Improving Rice Trade Prices! Call for Ideas for a Stone Removing Machine with a Simple Mechanism! (Tanzania)	2 teams (12 students)	1 team (2 students)	1 team (5 students)	–	**4 teams (19 students)**
Total Number of Teams	**13 teams (75 students)**	**1 team (2 students)**	**five teams (21 students)**	**1 team (3 students)**	**20 teams (101 students)**

Source: JICA Survey Team

As a result of the review of each challenge, the following team decided to proceed with prototyping.

✓ Challenge 1: Call for Ideas to Prevent the Spread of COVID-19 Infection Through the Power of Digital Fabrication!

-> A team of Nagaoka College (for Rwanda), which proposed a temperature measurement, disinfection and passageway separation gate, and a team of Sasebo College (for Kenya), which proposed VR classrooms, went on to prototyping.

✓ Challenge 2: Call for Ideas for Improving the Productivity and Quality of Paving Blocks Using Waste Plastic!

-> The Kitakyushu College team, which proposed the rotary agitation dryer, went on to prototyping.

✓ Challenge 3: Promoting the Digitization of Rural Areas! Call for Ideas of Radio Wave Map Made and Shared by Everyone!

->The Kitakyushu College team, which proposed the Android app and drone, went on to prototyping.

✓ Challenge 4: Improving Rice Trade Prices! Call for Ideas for a Stone Removing Machine with a Simple Mechanism!

->The Nagaoka College team, which proposed a small- and medium-sized stonewalling machine using grain selection boards and fans, went on to prototyping.
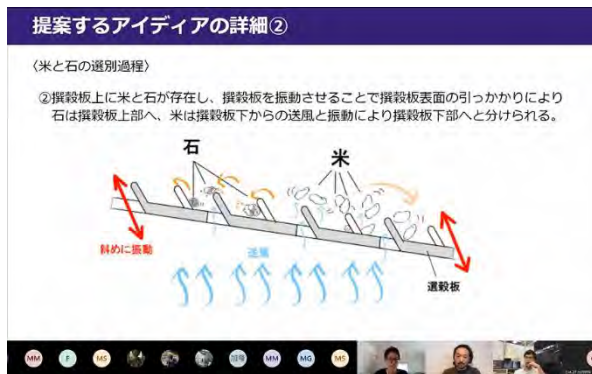
Presentation (Challenge 4)	Presentation (Challenge 3)

Source: JICA Survey Team

4.3 Prototyping and Follow-up

4.3.1 Final Report Meeting (September 9,2021)

The selected teams conducted prototyping and demonstration in Japan and Africa. The final report meeting for JICA was held on September 9, 2021, for the participating teams of the JICA-KOSEN Open Innovation Challenge 2020.

Date and time: September 9, 2021, 4:00 p.m. - 6:00 p.m.

Place: Online

Attendees: About 70 people (teachers and students of KOSEN, and JICA officials)

Program

16:00-16:05 Opening remarks by Mr. Wakabayashi, Deputy Director, Africa Division, JICA

16:05-16:15 Briefing on JICA-KOSEN Open Innovation Challenge 2020

Final report by JICA-KOSEN OI 2020 participating teams

16:15-16:30 Nagaoka College Presentation (and Q&A): Challenge 1 "Call for Ideas to Prevent the Spread of COVID-19 Infection Through the Power of Digital Fabrication" (Rwanda)

16:30-16:45 Kitakyushu College Presentation (and Q&A): Challenge 2 "Call for Ideas for Improving the Productivity and Quality of Paving Blocks Using Waste Plastic!" (Ghana)

16:45-17:00 Kitakyushu College Presentation (and Q&A): Challenge 3 "Promoting the Digitization of Rural Areas! Call for Ideas of Radio Wave Map Made and Shared by Everyone!" (Mozambique)

17:00-17:15 Nagaoka College Presentation (and Q&A): Challenge 4 "Improving Rice Trade Prices! Call for Ideas for a Stone Removing Machine with a Simple Mechanism!" (Tanzania)

17:15-17:30 Nagaoka College Presentation (and Q&A): Challenge 0 "Call for Ideas for a Sustainable Food Production and Supply System for the Realization of a Circular Society! (Productivity Improvement of Recycling System by Using BSF) * Reverse Innovation Theme of Nagaoka College" (Japan and Kenya)

17:30-17:40 General comments (Ms. Masuda, Director, Africa Division, JICA)

17:40-17:55 Question and answer session and comments

17:55-18:00 Adjournment

Outline of Implementation of Prototyping and Follow-up (as of the end of December 2021)

The results of prototyping and follow-up at the time of submission of this report are summarized in the table below. The activities toward on-site demonstartion were conducted despite the restriction of the extracurricular activities and in-person and in-school activities of the colleges in accordance with the declaration of the state of emergency in Japan, and the effects of the lockdown caused by the spread of the COVID-19 in Africa.

Table 4-6　Imprementation Result of Prototyping and Follow-up (JICA-KOSEN Open Innovation Challenge)

| Target country	Challenge	Team	Product outline	Progress in the course	Results of implementation
Kenya	Challenge 1: Call for Ideas to Prevent the Spread of COVID-19 Infection Through the Power of Digital Fabrication!	Sasebo College	–	• Online meeting with JKUAT on November 11, 2020. • Review target content and design specifications.	• The major members graduated in March 2020, making it difficult to continue the project.
Rwanda		Nagaoka College	[Preventing the Spread of COVID-19 Infection Using Temperature Measurement, Disinfection, and Pathway Separation Gates] In collaboration with the IPRC Tumba, the team developed a temperature measurement, disinfection, and passageway separation gate to prevent the occurrence of COVID-19 clusters at the school.	• The first prototype was produced before Challenge Day. • Online meeting with IPRC TUMBA (About 10 participants including vice-principal, teachers and students) on November 10, 2020 (Proposals and discussions with Nagaoka College). • Whatsapp Group established to share information. • Design discussion with NAZE on November 26, 2020. • Online meeting with IPRC TUMBA on December 15, 2020 (IPRC TUMBA proposal, matching of both proposals). • Online meeting with IPRC TUMBA on January 22, 2021 (specification review). • Online meeting with IPRC TUMBA on February 26, 2021 (progress check). • Online meeting with IPRC TUMBA on May 14, 2021 (prototype review). • Share 3D print data and software with GitLab to IPRC TUMBA. Procurement of hardware and equipment in Rwanda.	• The prototype on the Japanese side was completed, and demonstrations were held for the Rwanda side. • The Rwanda-side prototype was assembled despite the impact of the Kigali lockdown. However, there was a defect in the system of the local specification, and corrective action is being taken.
Ghana	Challenge 2: Call for Ideas for Improving the Productivity and Quality of Paving Blocks Using Waste Plastic!	Kitakyushu College	[Rotary stirring dryer for paving block manufacturing using waste plastic] In collaboration with Neplast Ghana Ltd., a local company, the team developed a device to efficiently and inexpensively dry plastic, which is part of the process of manufacturing paving blocks from a large amount of waste plastic.	• Online meeting with Neplast on October 16, 2020 • Prototyping materials were already available, and prototyping at the manufacturing center. • The prototype was completed in April, tested multiple times, and improved. • Online meeting with Neplast on May 13, 2021 • Improvements were made to the ventilation and steam discharge parts, and transportation was carried out in September 2021.	• A remote demonstration was held on October 22, 2021. Plastic, dried in the sun before, can be dried in about 30 minutes. • Considering installation of a heat source to further reduce drying time.
Mozambique	Challenge 3: Promoting the Digitization of Rural Areas! Call for Ideas of Radio Wave Map Made and Shared by Everyone!	Kitakyushu College	[Radio Wave Map Creation and Sharing System for Digitization of Rural Areas] The team developed a radio wave measurement system to improve unstable radio wave conditions in rural areas in order to facilitate rural development using digital technology.	• Online meeting with Nippon Biodiesel Fuel (NBF) on October 13, 2020. • December 16, 2020, meeting with drone manufacturers to discuss domestic drone demonstration (However, in Japan, drones equipped with smartphones are not allowed to fly, so the plan was abandoned.) • Software prototyping is in progress. Drone use is accepted in Mozambique, but reviewed from a sustainability perspective. (In the end, it was demonstrated on a motorcycle, not a drone.) • In June, connection between the front end and the back end was completed.	• Field demonstration (remote) from July to August 2021. Measurement of radio wave conditions and intensity and heat mapping succeeded. • The system was transferred to Japan Plant Fuel in December 2021.
Tanzania	Challenge 4: Improving Rice Trade Prices! Call for Ideas for a Stone Removing Machine with a Simple Mechanism!	Nagaoka College	[Small and Medium Size Stone Remover Using Grain Selection Plate and Fan] In cooperation with WASSHA Co., Ltd., the team aimed to improve the transaction price of rice by developing a machine to remove pebbles from rice and popularizing the market with Stone Free high-quality rice.	• Online meeting with WASSHA on October 21, 2020. • Design discussion with NAZE on November 26, 2020. • Prototyping materials were available. • As of June, 2021, the design has been completed and parts fabrication and assembly were being carried out simultaneously. The team members were late for work due to job hunting and entrance exams.	• The prototype was built in September 2021, but the vibration was so severe that it needed improvement. • The prototype is being improved in cooperation with the NAZE.

Source: JICA Survey Team

Challenge 1: Demonstartion of Aniti-COVID-19 Gate in Japan (2021, Nagaoka College)

Challenge 2: Prototype of Plastic Drying Machine (2021, Kitakyushu College)

Challenge 3: Demonstartion of Radio Wave Map in Mozambique (2021, Kitakyushu College)
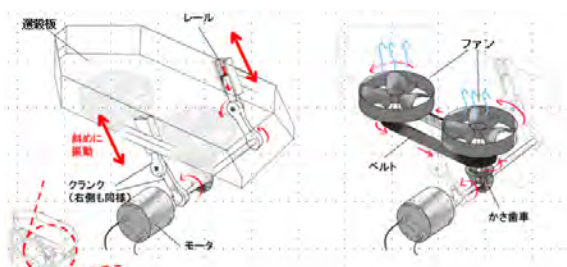
Challenge 4: Mechanism of Stone Removing Machine (2021, Nagaoka College)

Source: JICA Survey Team

4.4 Achievements and Lessons Learnt from KOSEN Open Innovation Challeneg powered by JICA

In KOSEN Open Innovation Challenge powered by 2020 as the 2nd year, though the implementation method had to be changed from FY 2019 due to the impact of the COVID-19, the following achievements were obtained.

[Results of the KOSEN Open Innovation Challenge powered by JICA 2020]

● The Challenge Day (proposal preparation and review meeting) in FY 2019 was held in the form of a training camp, but in FY 2020, it was held remotely due to the spread of the COVID-19. However, as a result, a total of 101 students, more than double the number in FY 2019, participated from the 4 colleges that signed MOUs on the JICA-KOSEN Innovation Platform.

● The team, which was selected at Challenge Day, was expected to conduct prototyping and then travel to the site in Africa to demonstrate once the COVID-19 had resolved. However, the COVID-19 was not end during this project, and the demonstration was carried out remotely. Although it was difficult for students to operate the prototype by themselves in the field, the plastic dryer in Challenge 2 was able to dry plastic pieces in about 30 minutes that had been dried in the sun, and the radio wave map in Challenge 3 measured the radio wave conditions in the field and displayed them on the map. The result was consistent with the objective of this program, which is to solve social issues in Africa.

On the other hand, lessons learned from continuing this program are as follows.

[Lessons from the JICA-Technical College Open Innovation Challenge 2020]

● Expansion of participating schools, students and teachers:

In FY 2020, more than twice as many students participated as in FY 2019, but the number of schools itself has decreased. In addition, a large number of students from some colleges are participating, and the expansion of the number of participating schools and the number of participating students from each school is a challenge. In addition, it is important to expand the number of teachers who will be able to understand and cooperate with this program, because the cooperation of teachers is particularly necessary for prototyping when the proposal is adopted.

● Securing cooperation from local partners:

In this program, the presence of local partners is essential in presenting issues and conducting field demonstrations. In FY 2020, in view of the situation of the spread of the COVID-19, we secured local partners in view of enablement of an on-site reception for sending prototypes and conducting demonstrations remotely. The same situation is expected to continue in the future, and the challenge is to secure cooperation of local partners who can communicate even remotely without problems. In this regard, the "Project to Solve Issues in Africa and Local Region in Japan Through Reverse Innovation Linking the Nagaoka Manufacturing Ecosystem and Africa" of FY 2021 selected 2 persons who had studied in Japan under the ABE Initiative as local partner. The cooperation with the graduates of the ABE Initiative may be a solution.

● Technical support:

In carrying out the prototyping, Kitakyushu College received cooperation from the Manufacturing Center and Next Technology, a startup company originating from Kitakyushu College, while Nagaoka College received cooperation from the Nagaoka Activation Zone of

Energy NAZE and Nagaoka University of Technology. While the ideas and technologies of students are impressive, experience, skills, and expertise may be required when making products for social implementation. As mentioned above, when expanding the number of participating schools, there may be cases where there is no backup system such as in Kitakyushu and Nagaoka, and it is necessary to establish a technical support system as part of this program.

We believe that this program, with the cooperation of many concerned parties such as participating colleges and local partners, has achieved the results that we initially aimed for. In FY 2021 and beyond, it is hoped that "Project to Solve Issues in Africa and Local Region in Japan Through Reverse Innovation Linking the Nagaoka Manufacturing Ecosystem and Africa" will promote the resolution of social issues in Africa in collraboration with the technology and ideas of KOSEN students.

Chapter 5 Trial Management of Platform

5.1 Consideration of Platform Measures

5.1.1 Initial Plan

An online information site (web platform) was planned to be developed to organize, update, and share information on various issues in order to conduct a trial operation of the "STI for TICAD Open Innovation Platform" (tentative name). Specifically, such a web platform was supposed to be developed to collect information on issues in the field from JOCV and JICA project experts, and to enable matching of issues and solutions through interactive communication by not only providing information on issues, but also posting information on companies with solutions and comments. In addition to providing information on issues, the site will also include information and comments from companies that have solutions.
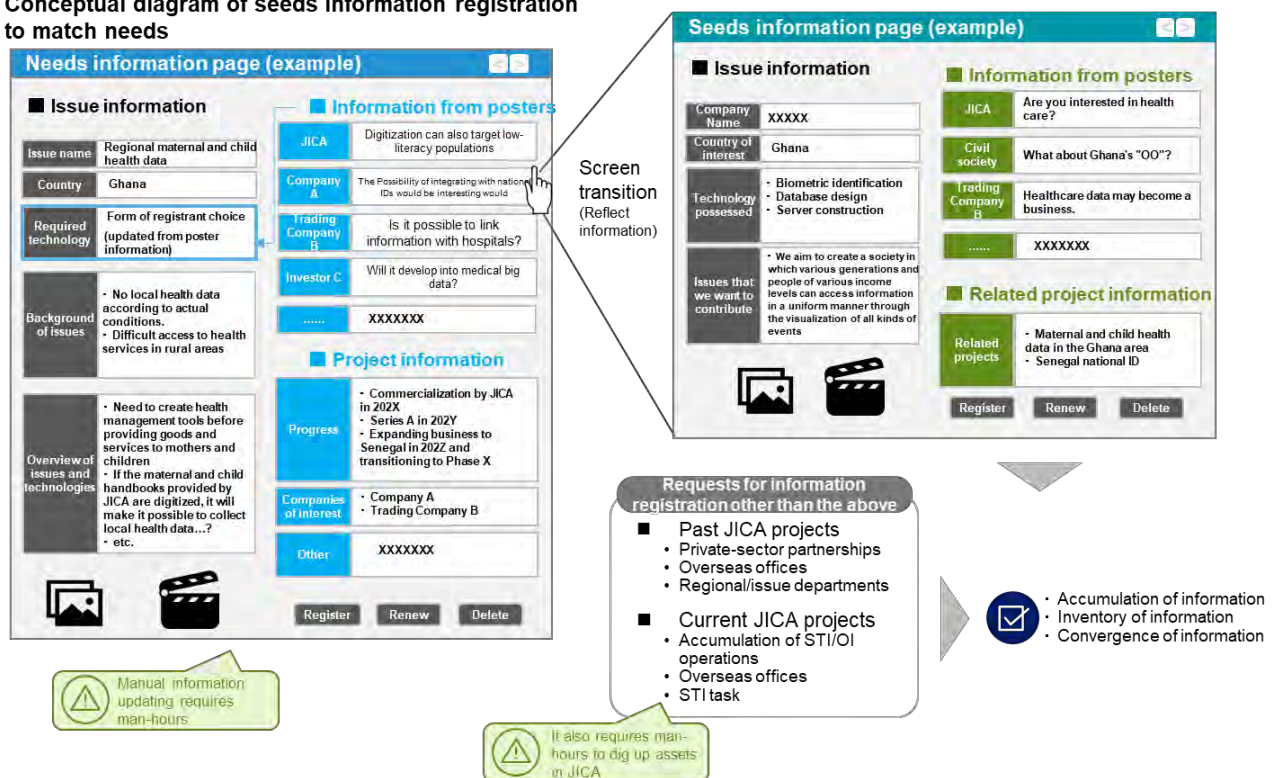
Figure 5-1   Image of Information to be Postedon the Web Platform

Source: Based on Disscussion with JICA by JICA Survey Team

The survey team also discussed the internal process of JICA to approach the issues raised from the field, and proposed the possibility of establishing a review committee, as shown in the figure below.

Process from JOCV draft to platform posting (confirm understanding of January 31 meeting)
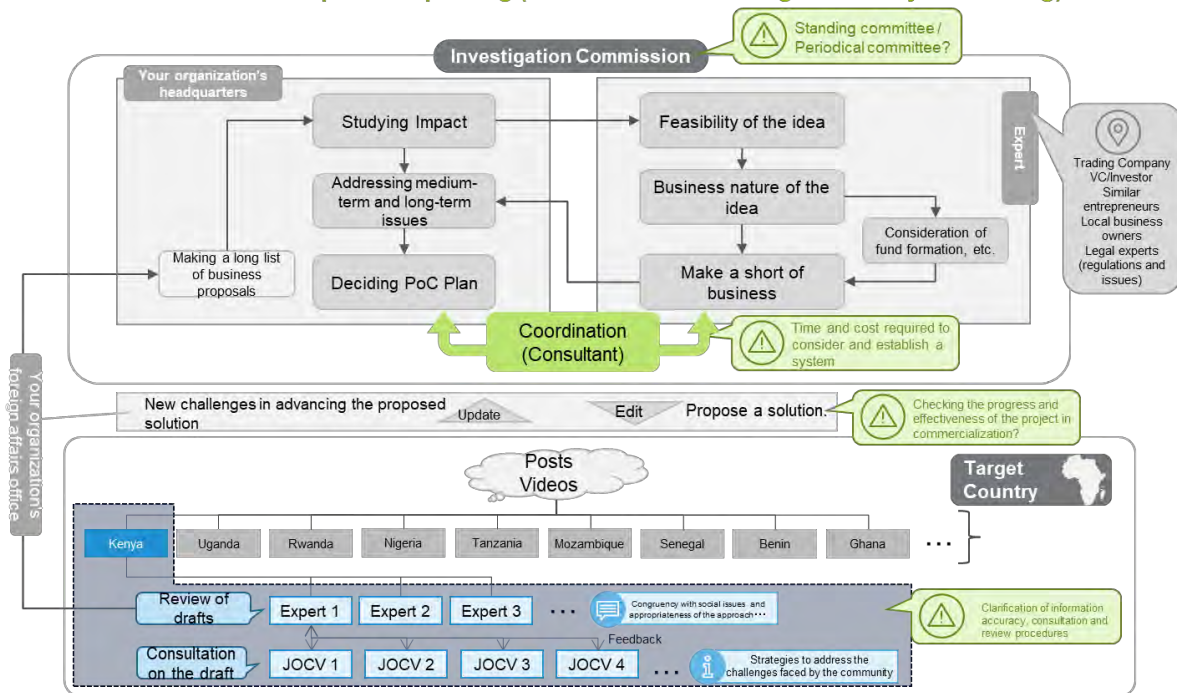
Figure 5-2　Proposal of Process for Issues Raised from the Field

Source: JICA Survey Team based on disscussion with JICA

5.1.2　Change in Initial Plan

However, as taking into account JICA's information security policy, it would not be easy to control the information on the web platform, where non-JICA personnel can freely post comments, and that JICA would need a considerable amount of manpower to ensure the authenticity of the information as a result of discussions with JICA's Africa Division. Furthermore, when using web services outside of JICA, it is difficult to operate the platform in a timely manner because it takes three business days to update the information due to JICA's internal procedures. In addition, it was found that there were several issues such as the risk of handling personal information such as user information. For this reason, this survey changed the initial plan for the web platform and reconsidered it with a view to utilizing external services to match the issues and solutions.

There are three options: (1) develop an original website, (2) develop an external website operated by a government agency, or (3) develop an external website operated by a private company. For (2), this survey used J-Good Tech as an example, and for (3), this survey used NINE SIGMA as an example, and compared them as follows (the details of both services are described later). As a result of discussions with JICA's Africa Division, this survey decided to implement Option B (① + ②) and Option C (① + ③) as shown in Figure 5-4.

	① Development on the original website	② Development on external sites operated by public offices (J-Good Tech)	③ Development on external sites operated by the private sector (NINE SIGMA)
What to ask for a contractor.	• Create a new website to accumulate information about both needs and seeds • Manage Contents Management System (CMS)	• Post issues on the website and call for technologies • Publicize the information through newsletters, etc.	• Post issues on the website and call for technologies • Search for companies and research institutes with technologies meeting a theme and request proposals.
Price	A few million yen	• Post information on the existing sites for free	Though it depends on the subject of public offering (like only Japanese companies and/or foreign companies), it costs several million yen per matching.
Advantage	• Operation under full control of JICA • Reasonable cost • Direct and timely communication with users • Any number of issues can be posted	• Experience in collaboration with JICA • Free access to network to SMEs • Possible to create a special web page (for a fee)	• Utilize their network of companies (and research institutions). • Technology matching with solution providers is possible
Disadvantage	• Need to build a network of companies with technologies from scratch (attract customers on our own) • Depending on the issue, the project may not be materialized • Need to secure the security matter (server, etc.)	• The member companies may not be interested in countries outside of ASEAN • Depending on themes, no company submits a proposal • Limited resources of contractors	• Little knowledge of business in developing countries • Client is responsible for business matching • Limited number of issues that can be posted • Cost (long term collaboration?)

Figure 5-3　Comparison of Proposal for Online Platform Service

Source: JICA Survey Team
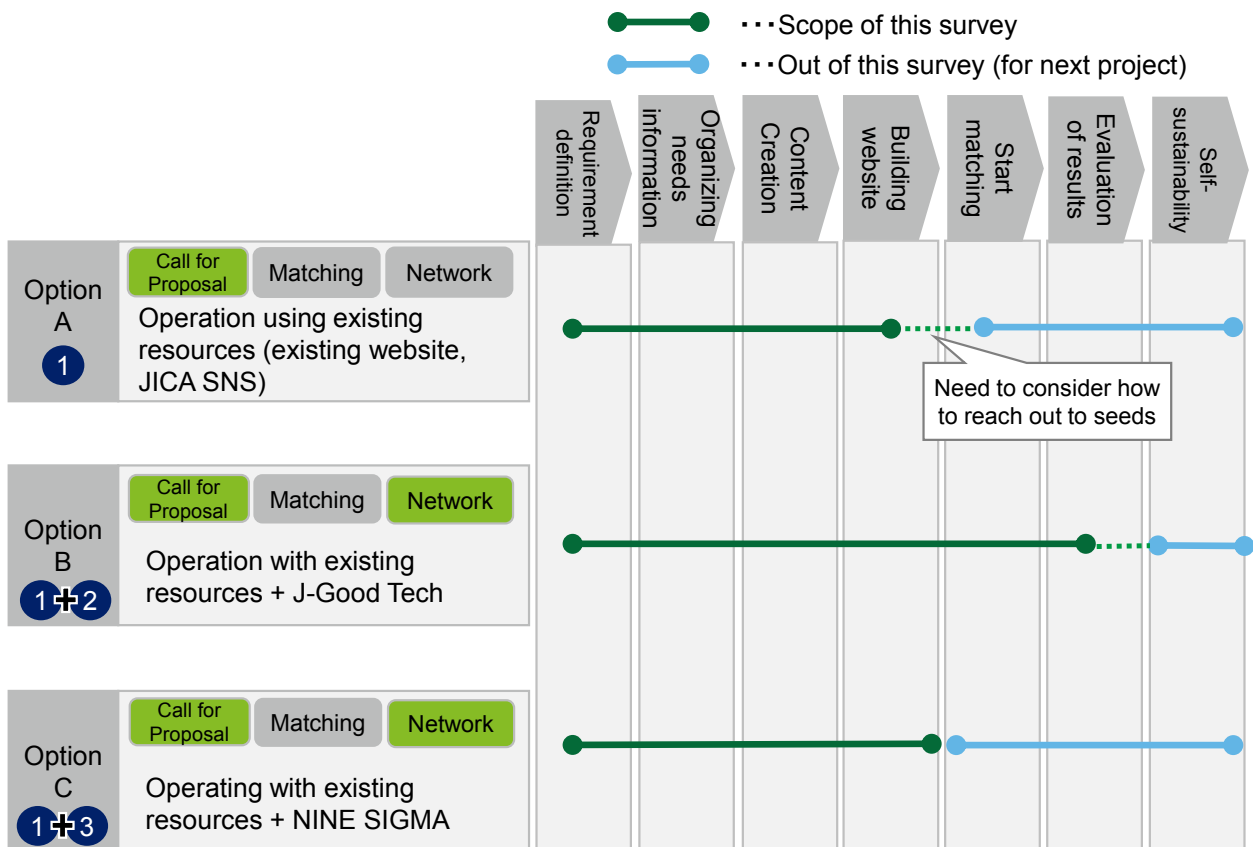
Figure 5-4　Combination of Proposed Online Platform Services

Source: JICA Survey Team

5-3

The details of ①～③ are as follows

➢ For the development of the original website, based on the website "Africa Open Innovation Challenge" built in the first survey (not a web platform for interactive matching of issues and solutions), it was decided to proceed as a website for disseminating information for implementing open innovation.kak

Figure 5-5 Africa Open Innovation Challenge on Website

Source: JICA

➢ As for the development of external sites operated by public offices, since JICA has already established a partnership with SME, this survey decided to collaborate with SME's "J-Good Tech"

Figure 5-6 Overview of J-GoodTech by SME SUPPORT JAPAN

Source: JICA Survey Team based on J-Good Tech website

> For the development of an external website operated by the private sector, we conducted a detailed comparative study because there are several services available, and as a result, we decided to adopt the service of Nine Sigma. As a result, we decided to use Nine Sigma's service. The details of this study will also be helpful in considering the operation of the "STI for TICAD Open Innovation Platform" (tentative name), and will be described in detail later in 5.1.3.

In addition to (1) through (3) above, this survey also decided to publicize the project on the "Corporate Competition Platform" website of JICA Private Sector Partnership and Finance Department as a way to utilize existing JICA resources. While trying out multiple methods as a platform, the application form will be unified, and by doing so, this survey will be able to analyze where the number of accesses and applications are coming from, and from where highly angular proposals are being submitted, in order to determine the future direction of the "STI for TICAD Open The policy was to gather information to examine the direction of the future "STI for TICAD Open Innovation Platform" (tentative name).
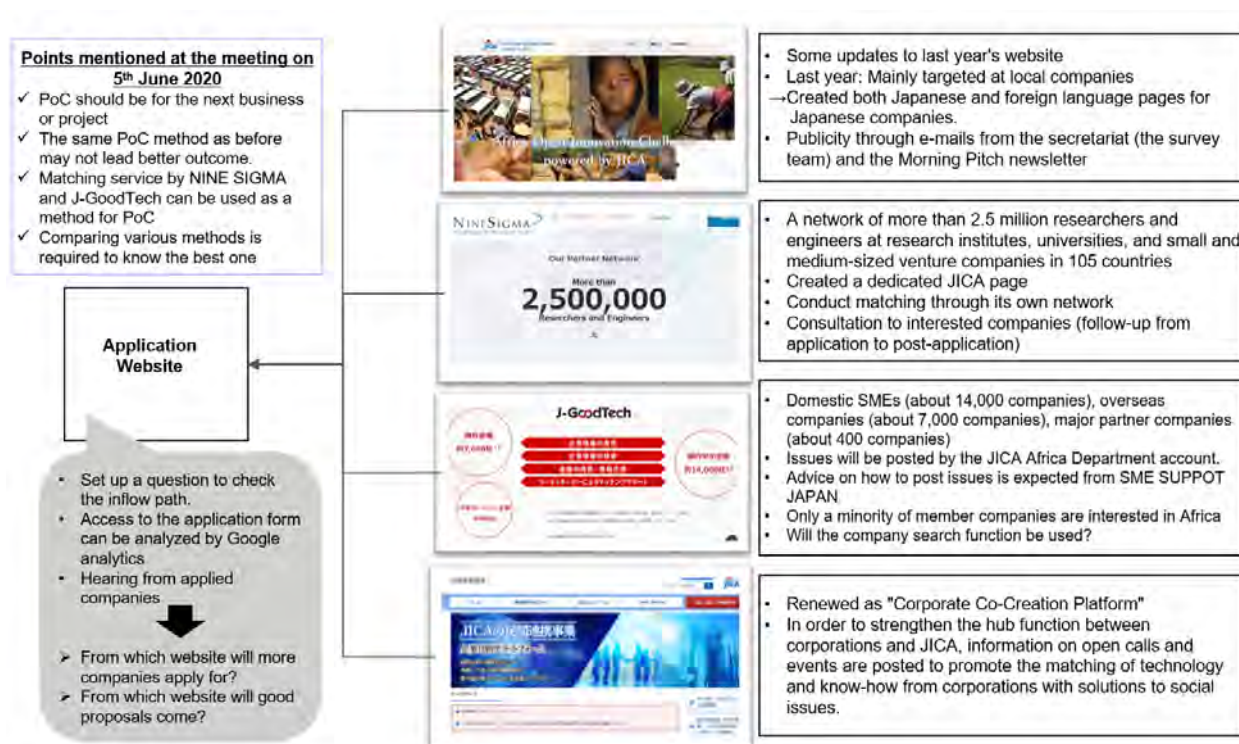

Figure 5-7   Trial of Multiple Platforms for Africa Open Innovation Challenge

Source: JICA Survey Team

5.1.3   Selection of External Matching Service Operated by Private Companies

(1)   Selection Method and Results

As mentioned above, services outside of JICA were also to be utilized for the matching of issues and solutions, and open innovation service providers were to be selected and utilized. In order to comprehensively evaluate the eligibility for this platform, seven criteria were set as requirements.

To begin with external online platform, maintaining JICA's uniqueness as well as visibility of JICA's presence is required. Assuming that JICA will continue to use the service in the future, an interactive mechanism is more likely to be expected, so two criteterias below will be added.

① Able to set up own special website

② Possibility of interactive response (including whether English is available)

In addition, the following five criteria were set as requirements for open innovation service providers to evaluate whether they can practically operate the services expected in the "STI for TICAD Open Innovation Platform" (tentative name).

③ Possesses an international network, with diverse and numerous companies and academia participating.

④ Abundant experiences in matching

⑤ The platform's functions have affinity with the business

⑥ Diverse solutions in a wide range of fields are provided

⑦ Able to work in Africa

The survey team selected six major open innovation service providers from the private sector (Nine Sigma, OPEN IDEO, AUBA, ANZA, Creww, and Linkers) and two from the public sector (Trade Tie-Up Promotion (TTPP) and J-Good Tech) as candidates. As a result of a comprehensive evaluation of the above seven criteria, Nine Sigma was determined to be the only platform that met all the requirements.

NineSigma is able to (1) set up a dedicated JICA website on the company's portal site (providing information on activities, individual issues and applications), and (2) create an interactive mechanism for the application process. (3) The company has an international network that other Japanese companies do not have, with more than 2.5 million researchers and engineers from research institutions as well as companies participating. We have more than 2.5 million participants, including not only companies but also researchers and engineers from research institutions. (7) There have been 11 projects in Africa, and many companies doing business in Africa, such as Ajinomoto Co.

On the other hand, candidates other than NineSigma did not meet the criteria (1) through (7) at the same time, and were judged to be unable to meet the requirements of this platform. The results of the comparative study of the candidate platforms are presented below.

Table 5-1   Comparison of Open Innovation Service

PF候補	①Establishment of company's own special website	②Interactive functions (including the possibility of English language support)	③International network, Diversity of participants and companies	④Track record of matching	⑤Affinity with this project (main function of PF)	⑥Diversity of Solutions	⑦Track record in Africa
NINE SIGMA	◎ Issue request for proposals by setting up themes on the company's special website	○ Allows dialogue with people interested in proposals during the procurement period (both in Japan and English)	◎ Network of more than 2.5 million engineers and researchers in 105 countries and more than 800 companies	◎ More than 5,000	◎ Applications and proposals from both needs and seeds	◎ Wide range of categories	○ Track record of Africa (11 projects)
OPEN IDEO	× Issue presented by PF. The name of the proposing company is announced	○ Ideas are solicited from around the world, and these are diffused and converged	◎ Ideas solicited: 21,216 from 195 countries	△ Approx. 70	△ PF set its own issues (needs)	○ Up to issues set in advance	○ Many social issue projects in Africa
AUBA	◎ Introduce company's own programs/themes on its own special website, and call for co-creation partners	×	× ■Approx. 15,000 companies, mainly major domestic companies and venture companies ■Less network with international companies.	◎ 22,000	◎ PR for a company, provision of a platform for searching for partners for all kinds of alliances	◎ All kinds of categories	◎ More than 200 projects in developing countries
ANZA	× (Only introduction of business outline of local companies seeking matching)	×	△ ■Japanese companies considering entering Africa ■Local companies in Africa (35 registered)	△ 35	△ Support for Japanese companies considering entering Africa, provision and matching of needs of local companies	○ Solutions specialized in Africa	◎ PF specialized in Africa
Creww	◎ Introduce company's own programs on its own special website and call for co-creation partners	×	× ■Focus on domestic entities (large companies, mega-venture companies, local governments, local companies participating) ■Less international networks	△ 546	○ Matching and events for new business creation and commercialization co-creation by startups + business companies	○ Full range of Xtech and IoT solutions	× One company participating in JICA project (Bangladesh)
Linkers	× No	×	× ■Focus on domestic entities (major manufacturers, small and medium-sized companies, and universities participate)	△ More than 350	△ Expert proposes proper partners according to the needs of the client	△ Mainly for manufacturing	× Mainly for Japan
TTPP	× No	×	◎ Listings of approximately 20,000 projects from 160 countries	◎ Many track records of a project database	△ ■Database that provides opportunities for BtoB transactions ■Cooperation with JETRO required	◎ Cooperation with JETRO projects and Overseas PF	◎ 264 related projects are listed (as of 7/28/2020)
J-Good Tech	○ ■Introduction of company's PR, etc. on the company's own page ■Dissemination of the company's needs and proposals to meet those needs	×	× ■Mainly domestic companies (more than 25,000 companies) ■Less international networks	◎ Approximately 15,000	○ Business matching sites that connect Japanese small and medium-sized companies with major domestic and overseas companies	◎ Many categories	× No track record

Source: JICA Survey Team

➢ While OPEN IDEO meets the requirements other than (1) , the company has adopted the format of soliciting solutions to social issues set by sponsoring organizations such as corporations and NPOs, and although it has solicited more than 20,000 ideas to date, it has only adopted 70 in the past 10 years. Furthermore, the possibility of matching (especially the possibility of collaboration with Japanese companies and academia) is extremely low when utilizing the system for this project as

considering the fact that there are only a few Japanese and Japanese companies registered and using the system.

- AUBA does not meet the requirements of (2) and (3). Basically, AUBA is good at connecting with major domestic companies and venture companies, and has difficulties in networking with international companies, researchers, and technicians.
- ANZA does not meet (1) and (2). In addition, although the company specializes in African businesses, it was only established in 2019 and has a limited track record.
- Creww does not meet (2), (3), or (7). The company provides a network for both needs and seeds, and is considered to have a high affinity for this business, but it has no track record in African projects。 Therefore, this makes it difficult to approach companies in related fields.
- Linkers does not satisfy (1), (2), (3) and (7). In addition, the company specializes in matching services through its network of Japanese manufacturing companies and third-party coordinators, so this makes it difficult to conduct this business, which also deals with fields other than manufacturing.
- TTPP provided by JETRO does not meet the requirements of (1) and (2). The platform can be used as a database for business projects to solicit applications from both needs and seeds, however, this may undermine the uniqueness of this research work as a JICA project.
- J-Good Tech does not satisfy (2), (3) and (7). Basically, it is a business matching site that connects Japanese small and medium-sized companies with major domestic and overseas companies. It does not have a large network of companies, researchers, and engineers interested in overseas business, nor does it have a track record related to Africa, so it lacks feasibility.

(2) Platform by NineSigma

NineSigma's main business is to support open innovation through the introduction of technologies and attractive organizations that accelerate the research and business development of companies. The company's platform, NineSights, is a portal site for open calls for global companies. The company posts individual open innovation issues on the site exclusively for its clients, and has the ability to collect proposals in a broad and efficient manner through active calls.

The process begins with analysis of the information on the issues presented by the client, followed by the creation of the solicitation guidelines (organizing the needs information for the solicitation), the search for promising partners, and the narrowing down of promising partners.
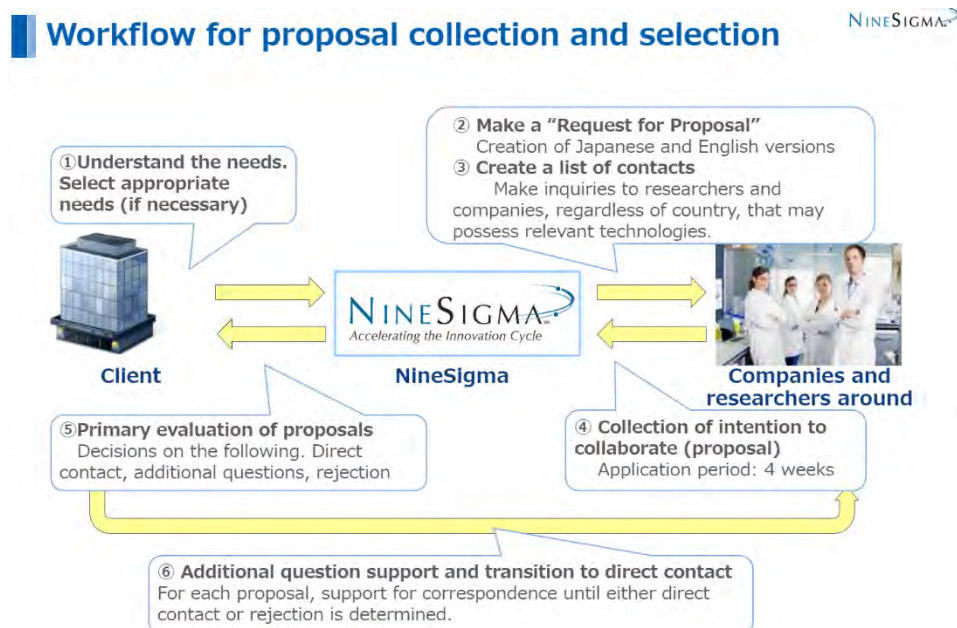

Figure 5-8 Process for Open Innovation

Source: NineSigma

In this study, the following tasks were outsourced to NineSigma in order to support the matching of issues and solutions.

> ➢ Create a special website for the Africa Open Innovation Challenge on Ninesights to publicize this activity and individual open innovation issues.
> ➢ NineSigma creates the site for Africa Open Innovation Challenge on the Ninesights and announce the issues of open innovation raised from individuals.
> ➢ Support the collection of proposals and selection toward the individual issues of open innovation
>> ・ Develop a call for proposals for effective solutions (draft prepared by the research team and edited for Ninesights)
>> ・ Public solicitation using the company's proprietary network
>> ・ Examine proposals from member companies of the company's proprietary network

5.2   Test Run of Platform

The results of the Africa Innovation Challenge, in which each country presented its own challenges and solicited solutions (PoC ideas), are described in Chapter 3. The following section describes how it functioned as a platform.

5.2.1   Access to the Application Form Website

First, the number of page views (PV) of the call form website (i.e. Africa Open Innovation Challenge website) from October 1 to December 31, 2020 was 8,804. Since the call for proposals for each country theme was launched in three installments (October 5 for Ghana and Zambia, October 19 for Senegal, and November 4 for Tanzania and Mozambique), the number of PVs increased at those times. In addition, as mentioned below, the Facebook paid advertising was used from November 21 to 26, which also increased the number of PVs during the same period.
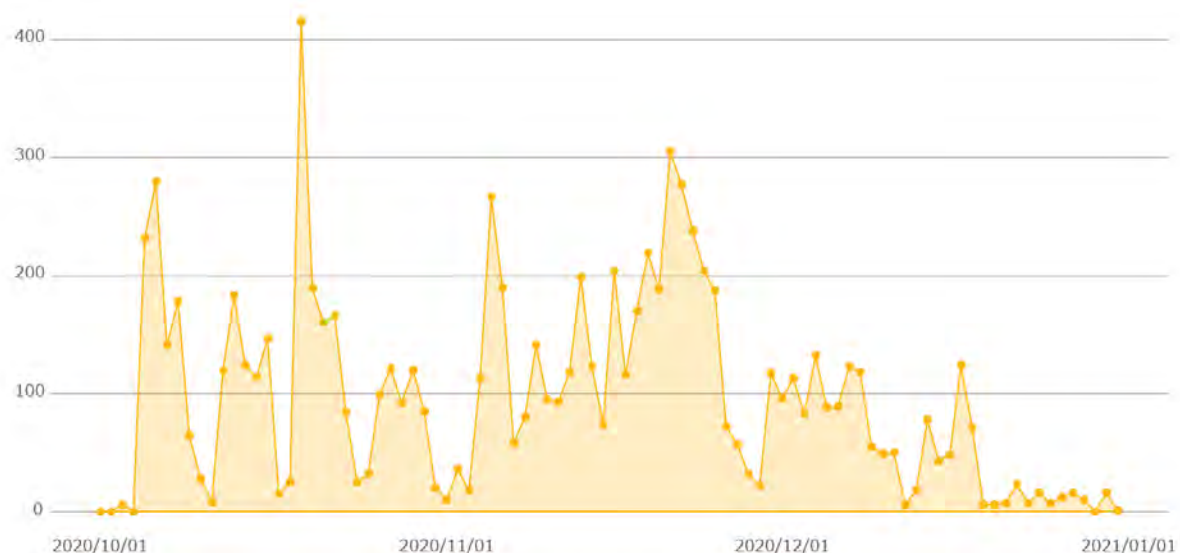

Figure 5-9   Change in the Number of Africa Open Innovation Challenge's Website

Source: The Survey Team

The number of visits (the number of users who accessed the site) was 4,304, of which 1,741 were visitors who cisited more than once. The bounce rate (the percentage of users who left the site after accessing it without moving on to other pages) was 62.66%. From this, it can be estimated that only about 40% of the users were interested in viewing the information after accessing the page.

5.2.2 The Inflow Routes to Application Websites

As for the inflow routes to the site, direct inflow accounted for 59% of the total, but this is thought to be due to the fact that many people accessed the site from URL links in e-mails and newsletters aimed at encouraging applications, or directly typed in the URL or accessed it from bookmarks by JICA officials and the survey team.
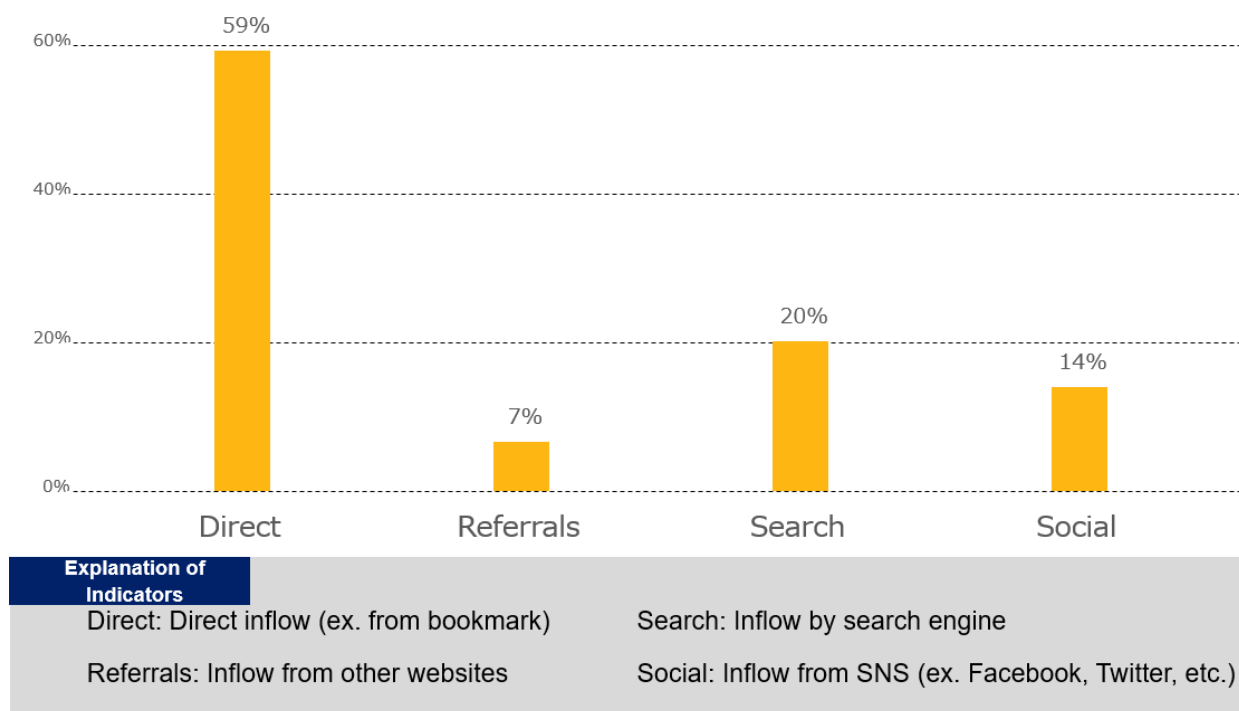

Explanation of Indicators	
Direct: Direct inflow (ex. from bookmark)	Search: Inflow by search engine
Referrals: Inflow from other websites	Social: Inflow from SNS (ex. Facebook, Twitter, etc.)

Figure 5-10 The Inflow Routes to Africa Open Innovation Challeng's Website

Source: The Survey Team

The following is a comparison of the inflow from the Africa Open Innovation Challenge page on Facebook (created on November 18, 2020), SME Organization's "J-Good Tech," Nine Sigma's "Ninesights," and JICA's "Enterprise Competition Platform" website. The following is a comparison of the inflow status from the four types of reference sources: SME Japan's "J-Good Tech," Nine Sigma's "Ninesights," and JICA's "Enterprise Competition Platform" website.

Table 5-2   Comparison of Inflow from Referrals

Referral Media	User	Bounce rate	Non-bounce user
Africa Open Innovation Challenge page on Facebook	564	84.19%	About 90
J-Good Tech	61	47.12%	About 32
Ninesights	164	63.05%	About 60
Corporate Competition Platform	186	55.10%	About 102

Souurce; JICA Survey Team

According to the table above, the inflow from J-Good Tech is overwhelmingly low compared to other sources. In the prevous interview with SME, many of the companies registered with J-Good Tech are not

interested in Africa as the figures demonstrates. On the contrary, many of the companies that dare to access this site are interested in this issue. That is to say, this is why the bounce rate is low.

Furthermore, from the comparison of the number of non-direct users between Facebook and the corporate competition platform, the following points are associated.

- The users who accessed the site from the URL link posted on the corporate competition platform are interested in initiatives such as this case (e.g., business development in developing countries). The bounce rate is low even though it is about 30% of the number of visitors from Facebook. This suggests that more users browsed this site than those who came from Facebook.

- The bounce rate was as high as 84.19%, however, the number of non-bounce users was lower than the number of users who accessed the site from the corporate competition platform due to the fact that the number of people interested in this kind of initiative was small.

In other words, it is important to publicize the project widely, but since this kind of project (especially business development in Africa) is not a topic that many companies are interested in, it is more effective to target the publicity to those who are interested. It can be said that such people are browsing the JICA Private Sector Partnership and Finance Department website.

Finally, a brief description of Facebook paid advertising will be provided. The survey team used Facebook's paid advertising feature for five days from November 21 to November 26 to encourage public participation on Tanzania and Mozambique. Targeting and results (reach and clicks) for each are as follows. Reach refers to the number of people who saw the ad at least once. Clicks are the number of clicks on the link in the ad that led to the destination specified by the advertiser within or outside of Facebook. The cost of this advertisement is 20,000 yen. Since it can be targeted by region and interest, it is considered to be one of the most effective ways to promote a wide range of people.

Table 5-3   Impact of Facebook Paid Advertising

Theme	Target area	Target age	Interest	Rearch	Click[8]	Rmark
Tanzania (Agriculture, Finance)	Nairobi, Dar es Salaam, Arusha, Moshi, Mwanza, Iringa	18～65	Startups, Proposal (Business), ICT, Startup ecosystem	40,432	1,116	About 63% access came from Nairobi and 28% from Dar es Salaam
Mozambuique (Education)	Maputo, Johannesburg, Cape Town	18～65	Startups, Proposal (Business), ICT, Startup ecosystem	23,192	501	About 34% access came from Maputo and 30% from Johannesburg

Source: JICA Survey Team

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[8] There is a gap between the number of clicks and the number of users in Table 5-3, but this is due to the difference in the measurement mechanism between the Google access analysis and Facebook clicks, which is the basis for the numbers in Table 5-3 (for example, if a Facebook advertisement is clicked multiple times in the same session, the number of clicks ＞the number of users, etc.).

Figure 5-11 Facebook Paid Advertisement Image

<div align="right">Source: Facebook</div>

5.2.3 Application Inflow

The total number of applications for the Africa Open Innovation Challenge was 78 (some companies applied for multiple themes, so the number of proposals was counted). (There were several cases where both the secretariat and Nine Sigma provided information to the same company, but the results below are based on the answers selected by the companies that applied.

In the case of Benin, NineSigma's services were not used, and Senegal and Benin are French-speaking countries, while Mozambique is a Portuguese-speaking country, which may have affected the number of applications.

Table 5-4   How to obtain information about Africa Open Innovation Challenge

Counrty (Theme)	Mail from secretariate	Nine Sigma	J-Good Tech	SNS (Facebook, Twitter, etc.)	Internet search	Others /No anwser	Total
Ghana/Zambia (Remote)	8	9	0	1	0	6	24
Senegaral (Tablet)	1	4	0	0	0	2	7
Senegaral (Weather info)	4	8	0	0	0	2	14
Benin (IT)	3	0	0	0	0	0	3
Tanzania (Agriculture)	3	5	0	0	1	2	11
Tanzania (Finance)	5	6	0	0	1	0	12
Mozamqiue (Education)	3	3	0	1	0	0	7
Total	27	35	0	2	2	12	78

<div align="right">Source: JICA Survey Team</div>

The largest number of respondents learned about the Africa Open Innovation Challenge through NineSigma or Ninesights, followed by emails from the secretariat (from the survey team). The "Other/No Answer" category consisted of information from development consultants, JOCV alumni mailing lists, local incubators, business partners, and acquaintances. In addition, application information through the MorningPitch newsletter, social networking services such as Facebook, and Internet searches led to few applications. In other words, these results suggest that targeted publicity to some extent is more efficient and effective than publicity to an unspecified number of people.

Next, in order to understand how proposals that better fit the Africa Open Innovation Challenge's solution requirements were submitted, the survey team created a similar table for only those proposals that passed the first round. This time, the largest number of proposals were received via email from the secretariat (by the survey team), followed by Nine Sigma and "other/no response. This is a natural result considering that the survey team, understanding the purpose and challenges of the Africa Open Innovation Challenge, contacted companies and academic research institutions with a certain degree of certainty. However, some of the proposals submitted through NineSigma were more general introductions of the company's products and services rather than proposals based on the background and challenges of Africa. For this reason, the number of proposals that passed the first selection process was not as large as the number of applications.

Table 5-5   How the Companies passed the 1ˢᵗ Screening Obtained Information

Counrty (Theme)	Mail from secretariate	Nine Sigma	J-Good Tech	SNS (Facebook, Twitter, etc.)	Internet search	Others
Ghana/Zambia (Remote)	2	3	0	0	0	1
Senegaral (Tablet)	1	1	0	0	0	1
Senegaral (Weather info)	2	1	0	0	0	0
Benin (IT)	3	0	0	0	0	0
Tanzania (Agriculture)	0	2	0	0	0	1
Tanzania (Finance)	4	1	0	0	0	0
Mozamqiue (Education)	3	0	0	0	0	0
Total	15	8	0	0	0	3

Source: JICA Survey Team

5.3   Considerations for Future Directions

Based on the results of the Africa Open Innovation Challenge, the following are points to consider for efficient and effective platform management. As for recommendations for the specific direction of platform management, the field survey is still in progress, so the survey team will only describe the points for consideration at the time of this Interim Report.

5.3.1   Putting Issues into Shape

In Chapter 3, the survey team narrowed down of themes in each country, but the survey team would like to address the importance of presenting specific issues (i.e., needs). In order for proposals and applications to be submitted that meet the needs of the local community, narrowing down (specifying and clarifying) the information on needs is considered to be an important point in the operation of the platform. For example, in Senegal, the Africa Open Innovation Challenge set two themes: effective use of tablets and weather forecasting. However, the number of applications for the first theme of effective use of tablets was 7 and for the second theme of effective use of weather forecasting 14. The reason for this gap of application was that in the first theme call for proposals, the aim was to solicit a wide range of ideas, so in addition to the "essential requirement: digitalization of extension/monitoring sheets," four types of proposals (visualization of extension/monitoring activities, efficient technical guidance and training, timely countermeasures against pests and weeds, and others (innovations for accurate and appropriate data acquisition, etc.)) were also included. The survey team believe this gap was partly due to the fact that application included four examples of proposals (innovations for obtaining accurate and appropriate data, measures to motivate agricultural extension workers, etc.) and broadened the title to "Innovations for Effective Use of Tablets for Agricultural Extension Workers. Although the survey team broadened the scope to accept more proposals, companies asked, "What are your biggest needs? , and "What exactly does 'effective utilization' mean? Since companies has to spend a certain amount of time preparing proposals, they find it difficult to make proposals without clear information on their needs. Therefore, in order to make an effective match, it

is necessary to present the issues as concretely as possible (use of images such as photos and videos, quantitative information on the specifications of the technology sought and the environment in which it will be used, etc.). In the Africa Open Innovation Challenge, the survey team were able to obtain detailed information from JICA offices and relevant project experts in each country, and that enabled the survey team to present specific issues.
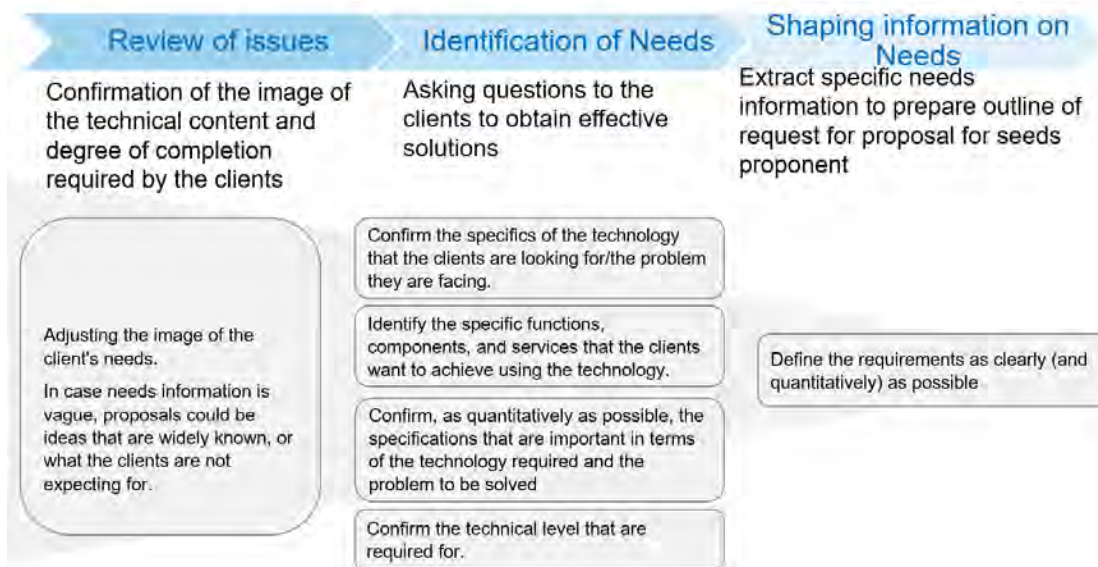

Figure 5-12   Process to Elaborate Needs

Source: JICA Survey Team

5.3.2   Construct JICA's Own Database JICA

At first glance, it may be important to widely publicize the project as an open innovation and solicit ideas from a large number of companies, etc. However, appropriate proposals came from companies that were approached with a certain degree of focus and from companies that received information through information networks (including word of mouth) among parties interested in the project. In relation to 5.1.3 above, there are many private sector services such as NineSigma that specialize in specific fields or region. By providing differentiated services, they provide added value to both the registered member companies and the companies that use the service to request issues.

JICA already has information on companies and academic research institutions that are interested in the international development field and developing country markets. Many companies apply for JICA's private-sector partnership projects every year. Even within individual projects, as in this survey, there are collaborations with multiple private companies, including PoC. For example, Project Ninja has received applications from over 2,700 companies. In addition, the JICA STI/DX Office's "Information Gathering and Confirmation Survey for Global (Wide-Area) DX Mainstreaming" is attempting PoC in collaboration with private companies. JICA Private Sector Partnership and Finance Department's "Information Gathering and Confirmation Survey on the Possibility of Utilizing Private Sector Technology in Developing Countries in Response to the Global COVID-19" is working with several private companies in the field of products and services. In addition, the SATREPS scheme is being operated in collaboration with academic research institutions. JICA already has abundant information on companies and academic research institutions that are interested in the field of international development and developing country markets. If the database can be created and utilized, it will enable to build a database of companies and academic institutions that will be the root of the matching service. In addition, it will be possible to effectively publicize (call out to) them in a way that focuses on the theme or region when implementing open innovation. For example, NineSigma's strength is its database of companies specializing in technical information, while JICA already has data that can be used as the basis for a database specializing in the field of international development.

In fact, most of the companies that applied for the Africa Open Innovation Challenge had already been involved in JICA's private sector partnership projects in the past, or had applied for Project Ninja if they were local companies. First of all, organizing and utilizing the information on related companies and academic research institutions within JICA into a database will lead to strengthening the platform function as JICA (improving the effective matching rate). This point was initially envisioned to be found through the establishment of a Web platform (an open Web platform with a mechanism for companies and other organizations to register their own information) (as mentioned above, this was difficult to achieve due to issues related to information security policy). However, there is a possibility that it can be realized by building a database within JICA. In order to create a database, the corporate information entry forms used in different schemes should be unified, for example, the form on the SDGs Business Support Scheme's pre-registration website and the application form for individual projects such as Africa Open Innovation Challenge and Project Ninja. For example, the pre-registration website form for the SDG Business Support Scheme and the application forms for individual projects such as the Africa Open Innovation Challenge and Project Ninja should be standardized (e.g., common required fields should be provided and a common input format should be used). In addition, JICA may specify the format to be used for compiling survey items related to companies, even if different departments are in charge of the survey, or introduce a system to automatically create a database using RPA.

It is proposed that only the basic information (company name, region, country, sector, name of product/technology/service provided, overview of product/technology/service) should be shared among the entry forms most probably on website used in different schemes, and make sure that the basic information data is stored in the designated columns when inputting information from a web form into an Excel file. At the same time, information on "region, country, sector," which are particularly important among the common items, a common set of options (e.g., the classification of regions and field/issues used by JICA) should be provided as optional question on the entry form. It will be possible to integrate information about companies which apply any schemes (projects) into a single Excel file and sort them by region, country, and sector. Although details need to be considered (for example, which items should be included as the common items such as the person in charge, contact information, more detailed information on the product/technology/service, etc. and what tools should be used to systemize the information), the following figure provides a rough draft for further consideration.
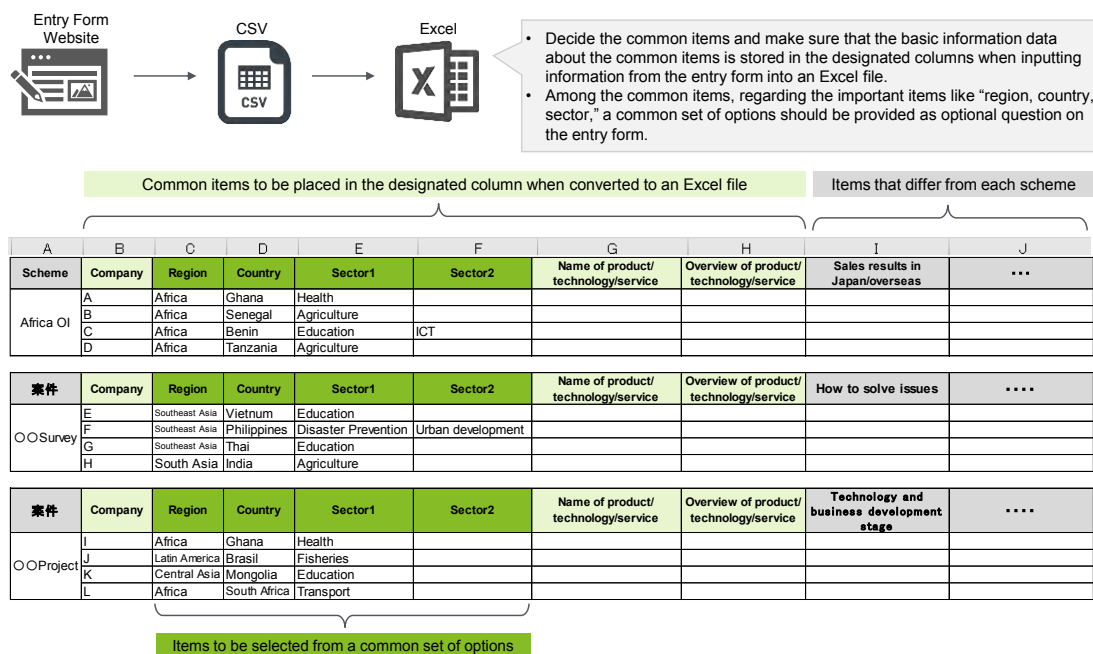

Figure 5-13   Drat Idea for Database Development

Source: JICA Survey Team

5.3.3 Expansion of the Target Participants

While the prime priority is as mentioned above, the next approach could be a strategy to expand the target audience. By widely publicizing the open innovation initiative, it could be an opportunity to involve companies that have not been involved in the field of international development. A concrete way to do this would be to utilize private matching services, as in this case. (For example, when including European and U.S. companies and academic research institutions, the services of NineSigma can be a possible reaserch tool). In addition, there are possible ways to conduct public relations with various stakehokders such as the platforms of public organizations like J-Good Tech of the SME Organization and the STI for SDGs platform of the Cabinet Office, organizations trying to solve social problems by technology such as Kopernik and ARUN Seed, Technology Licensing Organization (TLO) for bridging universities with high technology with patent and social needs, and industrial association related to specific technology such as Japan Deep Learning Association and The Japan DataScientist Society, etc. Furthermore, Facebook advertisements and other methods can be used to target an unspecified number of people. However, when taking this kind of approach, the main objective should be to expand the target audience, rather than expecting highly feasible proposals.

Table 5-6   Proposed Stakehoders to Expand the Target Participants

Category	Example	Merit for stakeholders
Public organization	J-Good Tech of the SME Organization and the STI for SDGs platform of the Cabinet Office, etc.	Support for overseas expansion of Japanese companies (a new option for support)
Organization trying to solve social problems by technology	Kopernik and ARUN Seed, etc.	Synergies with activities and new opportunities for companies to know about Africa
TLO acts as a bridge between universities	38 accredited TLOs [9] including TODAI TLO, Ltd. and TLO-KYOTO Co., Ltd.	Providing an opportunity to generate ideas for practically utilizing technology for society
Industrial association related to specific technology	Japan Deep Learning Association and The Japan DataScientist Society, etc.	Providing an opportunity to generate ideas for practically utilizing technology for society and develop new markets

Source: JICA Survey Team

5.3.4 Feedback from companies participating in the Africa OI

The response from the users of each PoC in the Africa Open Innovation Challenge was generally positive, as described in the results of PoC implementation in Chapter 3. On the other hand, in order to obtain feedback from the 7 corporations selected for the Africa Open Innovation Challenge, which is the PoC implementation side, a questionnaire survey on this program was conducted. As described in Chapter 3, the status of each PoC was different, so there were some variations in the content of the responses from them, but the following table summarizes the common points and lessons learned from their feedback.

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[9] Accredited TLO is able to treat with patent owned by national universities as business.
    （https://www.nippo.co.jp/tlo.htm） TLOs

Table 5-7   Result of Questionnaire on Africa Open Innovation Challenge

Question	Contents of Answer
Why did you participate in this program?	The main reasons for participating in this program were the desire to verify the usefulness of products in a new area of international development and the new market of Africa, and the compatibility of business strategy with the specific issues.
Would you like to continue collaborating with this program in the future? (on a 5-level scale)	• I really want to continue: 4 votes • I would like to continue in general: 2 votes • Either will do: 1 vote • I don't want to go on：0 • I don't want to go on at all：0
What incentives and motivation do you think are needed to work with this program? (Examples: investments, information, connections, etc.)	As incentives for participating companies, the following were mentioned: support in terms of cost (especially comments on the merits of being able to account for personnel costs), support in building relationships with local stakeholders (government, local companies, investees, etc.), collaboration with JICA technical cooperation projects, advice on business development, and publicity. Regarding the design of incentives for the participating C/P organizations, the concern was raised that if the advantage of being able to try out solutions for free is too much, there may be cases where the participants are attracted by the incentives rather than the genuine needs of solutions.
Could you tell us if there have been any changes in your company before and after the implementation of this program, and what changes have been made? (on a 5-level scale)	• Very significant change：4 votes • Significant change：2 vote • Change：1 vote • A little change：0 vote • No change at all：0 vote In addition to the above responses, the reasons for the "Very significant change" response included the fact that the PoC helped build relationships with local stakeholders necessary for commercialization, and the fact that the solution was customized and tested for the target country, which promoted overseas business development and research.
What are the advantages and improvements of this program?	Some of the positive aspects of the program were the cost support (especially the flexibility of the use of funds was well evaluated), the advice from JICA officials and the JICA survey team on the PoC implementation, and the support for building relationships with local officials (especially government agencies) that can only be reached through JICA projects. On the other hand, as areas for improvement, some participants suggested that support for closer communication with C/P organizations and local stakeholders and a longer PoC implementation period would have been better.

Source: JICA Survey team

From the results of the questionnaire above, it can be seen that the seven selected corporations generally felt that there was a great merit in participating in the Africa Open Innovation Challenge. In particular, 6 out of the 7 corporations answered, "I really want to continue" and "I would like to continue in general" to the question "Would you like to continue collaborating with this program in the future?". In addition, 6 out of 7 companies answered, "Very significant change" and "Significant change" to the question "Could you tell us if there have been any changes in your company before and after the implementation of this program, and what changes have been made?". This suggests that there is a certain level of need for the Africa Open Innovation Challenge from companies which would like to soluve socio-economic problems as a solution provider in Africa.

Regarding the last question asking "advantages and improvements" of this program, however, it should be noted that while advantages of this program include support for building relationships with local stakeholders (especially government agencies), which can only be reached through JICA projects, points

to be improved of this program also include support for closer communication with C/P agencies and local stakeholders. This can be interpreted as an indication that corporates have high expectations of JICA in terms of support for building relationships with local stakeholders. In some fields, there may be cases where the JICA field office does not necessarily have a close network with relevant parties, or where the JICA field office has limited resources for such efforts. For this reason, it is important to clearly explain the extent to which JICA can provide support to the corporates applying for this kind of progam at the time of call for proposals and screening stage. In addition, some of the selected companies were looking for opportunities to connect with local companies and investment partners. If JICA offices have relationships with the startup ecosystem and industry associations, JICA can provide expected support for them. However, if not, consultants (both in Japan and locally) familiar with the startup ecosystem and local industrial associations could play a role in providing support on behalf of JICA.

5.3.5 Outcome Factor for OI in Africa

As mentioned above, the companies that implemented this PoC were satisfied to a certain degree, then let's consider whether this PoC was a success or not.

As described in Chapter 3, DIVE INTO CODE and HAKKI were able to seize concrete opportunities (such as building relationships with the local government and local companies) to develop their own businesses in the target countries through PoC. In addition, solutions provided by Augumenta, Maad, JIRCAS, and Syno Japan were found to have the potential to be used in JICA's technical cooperation projects in the future. Also, it is possible to say that Hylable gained useful input by verifying the effectiveness of the solution in the African environment for future overseas business expansion. On the other hand, for the C/P organizations, it was not possible to fully change the behavior of the people involved or to improve the efficiency of their activities and operations in the limited period of about three months, but it was a valuable opportunity to examine the applicability and feasibility of using digital technology.

Looking at the results of the PoC in Africa Open Innovation Challenge, there is a possibility that the solution can be used for private sector's own business or JICA's projects as an exit strategy as shown on the table below. The success of this PoC can be defined by asking two simple questions as follows: "Have you been able to verify the possibility of using private sector solutions to contribute to solving development issues?" and "Will there be continuity after the PoC?" Considering the answers to these questions, it is possible to say that the main achievement of the Africa Open Innovation Challenge is the high success rate of the PoC. In particular, compared to the JICA Public-Private Partnerships Scheme (SDGs Business Supporting Surveys), where not many cases lead to continuous business or ODA collaboration after the survey, the percentage of success cases with a clear exit strategy can be considered higher in this PoC.

Table 5-8   PoC Exit Strategy

	Country	Corporate	Products & services	Exit Strategy	Good Factors/Background
Private Sector	Ghana and Zambia	Augumenta	Smart glasses	Utilization in JICA projects	PoC implementation in collaboration with TCP, which has a need for remote training in COVID-19 situation.
	Senegal	Maad	Tablet application	Utilization in JICA Technical Cooperation Project	Active involvement of C/P (SAED) and JICA experts to improve operational efficiency by using digital technology
	Senegal	JIRAS	Weather forecast	IDs provision for demo version to C/P, JICA Technical Cooperation Project, JIRCAS' own budget to continue	Active involvement of C/P (SAED) and JICA experts to improve operational efficiency by using digital technology
	Benin	DIVE INTO CODE	Learning programming	Private sector's own business	The company has strong intention to continue and well-connected local partner in addition to the active involvement of ADN
	Tanzania	Syno Japan	Agricultural marketing	Utilization in JICA Technical Cooperation Project	Active involvement of JICA experts to improve development impact by using digital technology and the possibility of more deployment
	Tanzania	Hakki	Credit scoring	Private sector's own business	The microfinance market in Kenya and Tanzania is active and technical availability has been confirmed
	Mozambique	Hylable	Visualizing dialogue in education fields	Private sector's own business	Cooperation with local stakeholders (IFP, MINEDH, etc.)

Source: JICA Survey Team

Therefore, we attempted to draw lessons by comparing the JICA Public-Private Partnerships Scheme (SDGs Business Supporting Surveys) and the way of implementing PoC in Africa OI.

Table 5-9   Comparison between JICA Public-Private Partnerships Scheme (SDGs Business Supporting Surveys) and This Survey

Differences between the JICA Private Sector Collaboration Scheme and this study

> The biggest difference may be to set detailed tasks and conduct targeted recruitment

Viewpoint	JICA Private Sector Collaboration Scheme (SDGs Business)	Survey
Problem setting	• Companies that apply for JICA's private sector partnership scheme also analyze the issues they face when they apply, but they take an approach where they originally have a solution they want to sell and look for issues that fit into that solution • **Many companies are solution-driven**	• The problem setting in this study was based on information from the local perspective from JICA offices, JICA experts, local government officials, and others who did not have solutions to sell, so the approach to problem setting was different. • **Problem-driven approach**
Recruiting	• Open Call on the Web Site • Problem-Solving Seminar	• Posted detailed proposal information in the open call on the website • Individual applications were encouraged from interested companies • Invited experts in the subject area (JICA experts, experts from outside JICA, C/Ps of partner countries) to participate in the screening process
Screening	• No presentation	• With presentation • Through the presentation, we were able to confirm the understanding of the solution and the motivation of the implementer (motivation and system for continuous efforts after PoC)
Implementation	• Cooperation system of partner country C/P may not be in place • Not much support from JICA office or JICA experts	• It was based on the needs of the partner country C/P and there was a good cooperation system • .JICA officials, JICA experts, and the survey team participated in regular meetings at high frequency, providing various information, coordination support with the partner C/P, and advice • The support from the JICA experts, who are familiar with the actual situation of the partner country C/P, was considered to be particularly powerful for the companies
Exit strategy	• Considered within the survey • In the case of basic research or project-oriented research, it can be either a dissemination, demonstration, and commercialization support project or an original business	• The possibility of using TCP was taken into account to some extent from the beginning
Administration and budget	• Man-hours are required to prepare administrative documents • Labor costs are not covered, and the items used are determined in detail	• Creation of administrative documents was limited, allowing us to focus on PoC implementation • Labor costs could be covered, and the system could be used flexibly (customization of the system also requires labor costs)
Etc.	• The position of an external person (consultant) is ordered by a company and sees only the relevant research	• Adopted companies (start-ups, local companies) that were difficult to recruit under the Minren scheme, and it worked out well • Consultants are working from a broader perspective than individual PoCs by receiving orders from JICA

Source: JICA Survey Team

Based on the results of the above comparison and the aforementioned feedback from stakeholders, the lessons to be drawn are summarized below.

➢ **Needs-driven approach**: Comparing the methods of theme setting, the theme setting in this study was based on interviews with JICA offices, JICA experts, local government officials, and others who were familiar with the problems and local conditions but did not have intention to sell any solutions. As a result, a purely needs-driven approach was taken rather than a solution-driven (supply-driven) approach. Of course, many of the companies that apply for JICA Public-Private Partnerships Scheme also conduct a certain amount of research on the issues and local conditions. However, in the case of research conducted by companies, the solutions they want to sell are already in their minds, so it would be natural to take a supply-driven approach in which they tend to look for issues matching solutions in mind.

➢ **Matching issues and solutions**: As mentioned above, a needs-driven approach is undoubtedly important, but setting issues without considering the solutions available in the market will not result in a match with solutions. In this survey, the themes were not set based on solutions, but the research

about potential solutions available in the marke was conducted and set up the final problems after getting some "idea" of the solutions. As a result, some companies, which were likely to be interested, with potential solutions were encouraged to apply for Africa OI by JICA survey team. (as described in 5.2.3, "Application Inflow").

➢ **Involvement of relevant parties in PoC implementation**: JICA experts and C/P who provided needs information when setting up the theme participated in the proposal selection process, which facilitated their cooperation during PoC implementation. Of course, there are advantages to having external experts as reviewers. However, if it is possible to involve not only the external experts but also those who are directly involved in the implementation and post-implementation activity of the PoC at the call for proposals and screening stages, it naturally brings about their active involvement in the implementation of the PoC since they may consider the PoC is an important issue that affect themselves.

➢ **Flexible procurement mechanism**: This survey differs from JICA Public-Private Partnerships Scheme (SDGs Business Supporting Surveys) in that the personnel cost of the selected company can be covered as a PoC cost and there is no need for complicated administrative procedures. This different approach from the JICA Public-Private Partnerships Scheme allowed the implementing companies to focus on their core business, such as system development, rather than on administrative procedures.

➢ **Localization to meet the needs**: Another success factor was the flexibility to respond to the requests from the users of the solution. In the JICA Public-Private Partnerships Scheme, it seems difficult to implement the PDCA (Plan-Do-Check-Act) cycle, which involves having the solution actually used, making improvements based on the feedback, and obtaining further feedback again, because of lack of personnel cost. However, in this PoC, since the personnel cost could be covered, it became possible to develop the system in an agile manner, and it is thought that both companies and C/Ps were able to gain practical learning from the PoC that cannot be obtained from simple survey.

➢ **Rapid PoC implementation**: As mentioned above, the Africa Open Innovation Challenge was different from JICA Public-Private Partnerships Scheme in several ways. Similarly, there are additional advantages when compared with technical cooperation projects. If such a PoC is to be implemented as part of a technical cooperation project, it needs to be included in the PDM from the beginning and clearly stated in the TORs of the consultant. However, it is difficult to do when it is unclear what kind of PoC will be conducted by which company with which solution. In this case, once the content of the PoC has been decided, the activities and evaluation indicators in the PDM need to be revised, and the contract with the consultant also needs to be revised, which requires certain procedures and time. Therefore, it makes speedy implementation difficult. In order to introduce solutions in a timely manner at a specific timing, such as the planting and harvesting season for agricultural projects or the start of a new school year for educational projects, flexible initiatives such as the Africa Open Innovation Challeng are more suitable.

In comparison with other schemes like above, the Africa Open Innovation Challenge had the advantage of being able to work with a high degree of flexibility without being bound by the framework of existing schemes and this is thought to be the reason for its high success rate.

Chapter 6 Recommendations for Future Africa Open Innovation Challenge

6.1 Recommendations for operational policies

Based on the discussion in Chapter 5, when the future direction of the Africa Open Innovation Challenge is considered, the importance of this program is to provide opportunity for both internal and external stakeholders of JICA to examine private sector solutions, especially for the problems that are difficult to solve by the traditional schemes such as JICA Public-Private Partnerships Scheme or technical cooperation projects. By utilizing superior solutions from private secotr, such problems can be solved more efficiently and effectively than ever before. However, as discussed in Chapter 5, the existing Public-Private Partnerships Scheme and technical cooperation projects are not easy to implement speedy trial to examine solutions because of the rigidity of the procurement systems and fixed activity plan. Therefore, the value of the Africa Open Innovation Challenge will be to play a complementary role that are difficult to be addressed by the existing JICA scheme.

To provide such an important value, Africa Open Innovation Challenge should hve a basic function of to collect detailed information on issues from JICA projects, mainly technical cooperation projects, and to solicit solutions from private companies and research institutes through public solicitation. Moreover, it will be possible to achieve highly accurate matching by encouraging companies with solutions related to the issues to apply based on JICA's own database as proposed in Chapter 5 (Section 5.3.2). The both functions, to collect detailed information on issues from JICA's internal stakeholders and to solicit high ptential solutions from external stakeholders, work to bridge between inside and outside JICA. Such function can bring about the value which is not found in existing JICA schemes. In addition, the Africa Open Innovation Challenge is expected to improve operational efficiency in JICA by unifying similar initiatives since many PoCs are implemented in different technical cooperation projects.

- Collect detailed information on issues in existing projects (especially TCP) and find solutions through public solicitation
- Accumulate information on companies interested in entering developing countries and their solutions through JICA Public-Private Partnerships Scheme, technical cooperation projects, Project Ninja, other projects that utilize digital technology, and similar initiatives by other donors, and then, highly accurate matching (encouraging applications) will be conducted
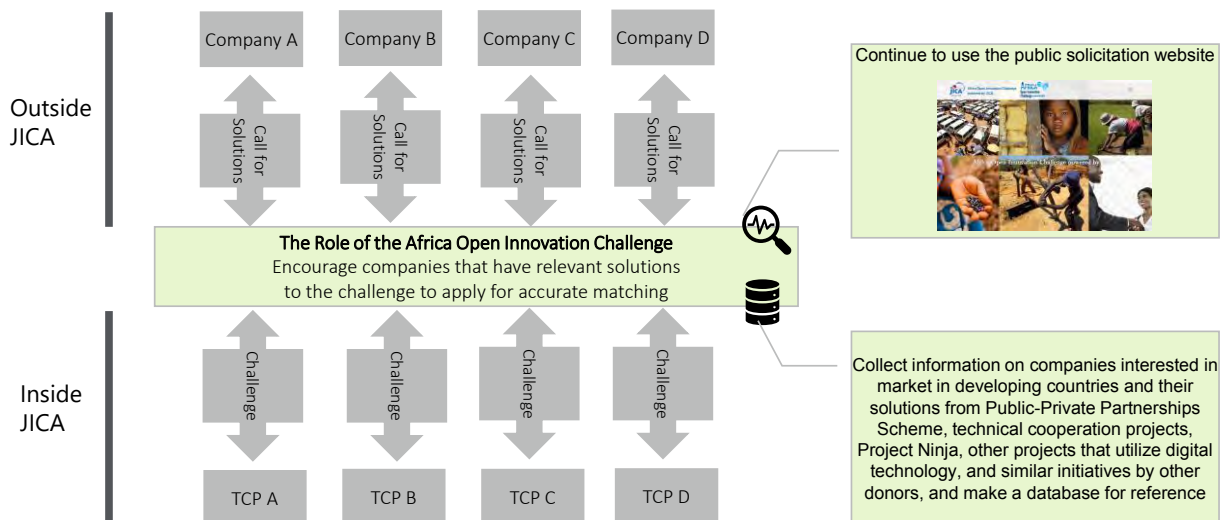

Figure 6-1   Success Factors and Considerations for Each Step

Source: JICA Survey Team

6.2 Recommendations for Management Methods

The following table shows the specific operational process and the proposed roles of the parties involved for the continued operation of the Africa Open Innovation Challenge in the future.

		Collecting challenges, narrowing down promising themes	Conducting in-depth research on the challenge, Selection of OI themes	Open application, Screening	PoC implementation	PoC evaluation
Implementation details		① Collecting challenges 【Option 1】 • Hold roundtable discussion on specific DX areas with JICA officials, experts, JOCVs and DX experts 【Option 2】 • Solicit challenges that require STI application via website and hold consideration meeting 【Option 3】 • As a hybrid of options 1 and 2, hold a roundtable discussion after collecting challenges in option 2. ② Narrowing down promising themes	① Conduct interviews with parties related to the promising theme ② Develop long list of candidate solutions ③ Confirm will of cooperation from local JICA offices, existing projects, and other relevant internal stakeholders ④ Decision on target countries and OI themes ⑤ Preparation of OI theme materials for public solicitation	① Annoucement • HP development • Public solicitation (through HP and SNS) • Individual approach to candidates ② Screening • Organize screening team • Application document review • Presentation screening	① Confirmation of PoC purpose, PoC plan and KPIs ② Contract with the selected company ③ Implementation of PoC	① PoC reporting ② Evaluation based on KPIs and decide whether to Go or No-Go ③ In case of Go, create a business plan
Role	**JICA**	• Collecting challenges • Narrowing down promising themes	• Organize implementation structure for OI (including obtaining cooperation from related parties) • Determination of target countries and OI themes	• Screening	• Confirmation of PoC purpose, PoC plan and KPIs • Support for PoC implementation	• Evaluation based on KPIs and decide whether to Go or No-Go • In case of Go, confirm the business plan
	Consultant	• Support for introducing innovation trends in specific fields at roundtable discussions • Support for website development to solicit challenges	• Support for conducting in-depth research • Identification of candidate solutions • Preparation of OI theme materials for public solicitation	• HP development support • Annoucement support • Screening support	• Support for confirmation of PoC purpose, PoC plan and KPIs • Contracts with selected companies • Support for PoC implementation	• Hold PoC report session • Support for creating a business plan in case of Go

Figure 6-2 Operational process and proposed roles of stakeholders

Source: JICA Survey Team

The success factors and points to be noted in each step are summarized in the figure below.
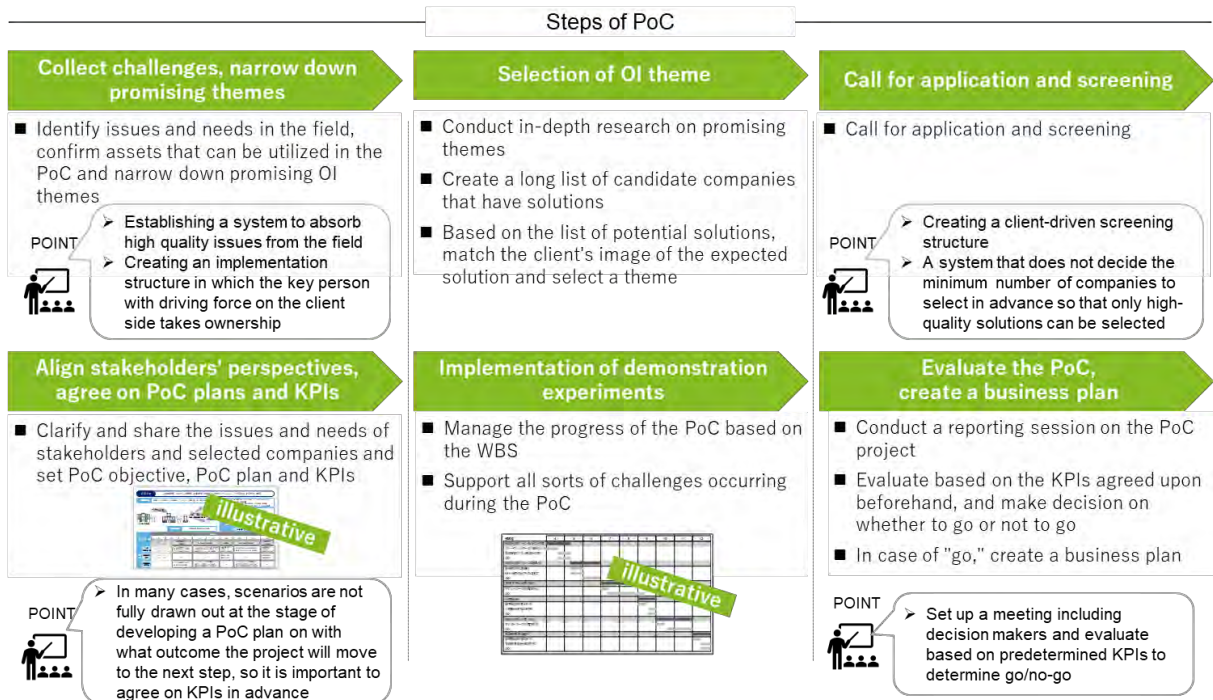

Figure 6-3 Success Factors and Considerations for Each Step

Source: JICA Survey Team

Particularly, in the phase of "collecting challenges and narrowing down promising themes," the key issue is how to continuously collect high-quality challenges from the field. In this study, 1) first, the JICA overseas offices in the target countries narrowed down the sectors such as health and agriculture, and sector surveys and examination of the applicability of digital technologies were conducted. In addition, themes were narrowed down by considering whether local stakeholders who were familiar with the local issues can be secured and whether the PoC sites could be secured. 2) Then, interviews and in-depth investigations were conducted with local stakeholders on the narrowed down themes, and the OI themes were determined. While we believe that the method used to set the themes for this survey was appropriate, there is room for improvement in terms of continuity because of the high workload involved in narrowing down the candidate themes. As an approach to continuously collecting issues and narrowing down the themes, the following initiatives could be implemented.

> Option 1
  - Hold roundtable discussions on specific DX priority areas with JICA officials, experts, JOCVs and DX personnel, to collect information and insights on challenges and needs, and exchange opinions on the applicability of digital technology (innovation trends in the specific area can be introduced to stimulate discussion).

> Option 2
  - Prepare a website for soliciting challenges that require STI application on the Africa Open Innovation website. JICA stakeholders, experts, and JOCVs can be periodicaly notified through official telegrams, e-mails, SNS, etc., to solicit challenges throughout the year. After the challenges are collected, consideration meeting on the appropriateness of the challenge as an open innovation theme can be held with the participation of a DX personnel.

> Option 3
  - As a hybrid of options 1 and 2, hold a roundtable discussion on the issues collected in option 2.

In this survey, the consultants conducted the above 1) and 2), however, in order for the JICA staff to take ownership of the project from the initial stage, it would be desirable for JICA to take the lead in collecting potential themes, conducting the initial screening, and organizing the assets and resources that JICA can provide (with support from consultants as necessary), and then outsource the work to consultants in phase 2) as necessary. In particular, one of the success factors of open innovation is the establishment of a system in which a key person with enthusiasm takes ownership and promotes the project. In addition to the phase 1) above, it is important to establish a system in which JICA assigns a person in charge of open innovation projects, and the person in charge consistently promotes the project from theme selection to PoC evaluation, while the consultant supports the activities.

In the "public solicitation and review" phase, if one solution must be selected for each theme, it may lead to the adoption of solutions that are not necessarily of high quality. In this study, a long list of candidate companies was developed, and individual approaches were made to each application at the stage of theme selection and solicitation, so there was no case of adopting a low-quality proposal. However, such a situation may occur in the future, so it may be needed to contract with consultants on a condition that no solution may be selected.

It is also important to agree on the KPIs between the PoC implementing company and related parties in advance before the PoC starts. It does not have to be rigid KPIs where it cannot be adjusted in the course of the PoC and certain level of flexibility should be allowed, but is recommended that KPIs be set in advance in order to promote and evaluate PoC while aligning the perspectives of all parties involved.

6.3 Recommendations for management structure

Even if JICA's own database proposed in Chapter 5, 5.3.2 is utilized, it is not easy to match the issues gathered from within JICA with solutions from outside JICA. It is necessary to have human resources who understand the issues on the ground in developing countries and at the same time are familiar with digital technology and have the ability to consider a combination of issues and solutions. In this survey, the consultants (JICA survey team) fulfilled this role through trial and error, but in order to continue operating the Africa Open Innovation Challenge in the future, it will be important not only to utilize external experts and consultants, but also to develop such human resources within JICA. For the time being, it is realistic to match issues and solutions with the support of the STI/DX group internally, which is responsible for promoting DX throughout the JICA project. One idea is to assign a person in charge of STI/DX to each department to work with the STI/DX group to accumulate knowledge about matching issues and solutions.

Another possible approach to human resource development would be to update the knowledge of each staff through in-house training in the field of DX, internal meetings to exchange opinions among STI/DX personnel (casual lunch meetings, etc.), and external meetings to exchange opinions with outside parties such as private companies, industry associations, and venture capitals .

Finally, in order for Africa Open Innovation Challenge to achieve greater impact, it is important to consider how the results can be expanded after the PoC is implemented. The Africa Open Innovation Challenge itself can be a means of building relationships (networking) with new actors, and the value of the Africa Open Innovation Challenge will be further enhanced by the expansion of the network. By continuing to run this cycle, the Africa Open Innovation Challenge can become a platform that not only connects issues and solutions, but also achieves significant impact.

END